TECHNICAL MEMORANDUM
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SURFACE WATER AVAILABAILITY OF THE CALOOSAHATCHEE BASIN

by

Andrew Fan
Raymond Burgess

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Water Resources Division
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EXECUTIVE SUMMARY

The purpose of this study is to quantify the surface water availability of the Caloosahatchee River Basin. The area covered in this study includes the fresh water zone of the Basin from Franklin Lock to Lake Okeechobee. For the purpose of analysis, the basin is divided at Ortona Lock into an East Caloosahatchee Basin (ECAL) and a West Caloosahatchee Basin (WCAL). The hydrologic data used in this study covers the period of 1966 to 1980.

Gross basin yield is defined here as the quantity of water that would emerge at the river (under a hypothetical natural state) when all diversion activities ceased. The actual or safe yield is that portion of the gross yield that can be used beneficially without producing undesirable effects; it is equal to the gross basin yield less the minimum flow requirement.

The minimum flow was established here as the quantity of water that must enter the river to replenish the losses due to evaporation and leakage at the gates and locks, under a critical drought condition, when all locks and gates are closed. The minimum flow refers to a design abstraction of the local inflow to the river and, as such, it is not controllable and should not be mistaken as a recommended regulatory inflow to the river.

A water balance method was used to derive the yields of the basin between 1966 and 1980. The yields were then analyzed by frequency analysis for different durations and months of a year. The results of the analysis are summarized below:

1. Irrigation water use is the largest water use in the Caloosahatchee Basin. It fluctuates considerably from month to month depending on availability of rainfall to supplement the irrigation demand.

2. Public water use (1980) represents approximately 27% of the total water use in the WCAL, but less than 1% in the ECAL. Public water use in the WCAL is the fastest increasing demand due to rapid population expansion in metropolitan Lee County. If the present trend continues, the public water withdrawal from the WCAL will double in approximately eight years.
3. Based on the tributary inflow data collected from 1978 to 1980, a water budget of the local inflow to the river in the WCAL was prepared. The water budget indicates that the tributaries contribute approximately 53% of the total basin inflow to the river, whereas the remaining 47% consists mainly of direct groundwater seepage and errors of the tributary flow data.
4. The local inflow hydrograph to the river from the ECAL was found to be considerably smoother than that from the WCAL, indicating that the flow attenuation effect of the ECAL is greater than the WCAL. This may be explained by the fact that the ECAL has a flatter topography, a greater proportion of the basin covered with wet land, and a thicker layer of sand overlying the basin.
5. The yields and demands of the ECAL and WCAL for different drought years, and for different durations and months of a year, are summarized in Figures 14 through 17. The annual yields and demands are tabulated below:

	ECAL		WCAL	
	Yield (inch)	Demand (inch)	Yield (inch)	Demand (inch)
Normal Year	12.0	1.2	10.9	1.9
10-Year Drought	2.5	2.0	6.0	2.6
20-Year Drought	0.8	2.4	5.1	2.8

6. Due to uneven time distribution of the yields and demands, the ECAL and WCAL are under deficient conditions for approximately four months in a normal year and approximately eight months in a 10-year drought.
7. May demarcates the end of the dry season and the beginning of the wet season. Storage in May is normally at its lowest level; therefore, May becomes the most critical month should rains arrive late.
8. Under the present structural configuration, the surface water of the Caloosahatchee Basin has been developed to its maximum capacity. Supplemental releases from Lake Okeechobee to meet downstream demands are essential during the drier months when a deficient condition occurs.

INTRODUCTION

PURPOSE

The purpose of this study is to quantify the surface water resources of the Caloosahatchee River Basin. The results of this study may serve as a guideline for further development, allocation, and planning of the water resources of the basin.

The present report is addressed to the fresh water zone of the basin between S-77 and S-79. For the purpose of this analysis, the basin is divided at S-78 into two hydrologic units. The East Caloosahatchee Basin (ECAL) and the West Caloosahatchee Basin (WCAL). The WCAL has a drainage area of 594 square miles which is about 60% larger than the drainage area of ECAL (372 square miles). The period under analysis is from 1966 to 1980 when the present configuration of the river evolved.

BACKGROUND

The Caloosahatchee River Basin is located on the west side of Lake Okeechobee and extends for a distance of approximately 60 miles to the Gulf of Mexico. The Caloosahatchee River is the largest outlet of Lake Okeechobee, receiving approximately 37% of the total surface water outflow from the lake. Hydrologically, the river can be divided into an estuarine zone and a fresh water zone with the Franklin Lock (S-79) as a dividing structure. Historically, under the natural state, the river could go dry during the dry season, and the estuarine (saline water) front could move as far in as the present Ortona Lock.

A series of hydraulic improvements on the Caloosahatchee River were initiated by the Corps of Engineers and much of the work was completed by

1966. Of significant importance are (1) the straightening and deepening of the river, notably in 1937, 1941, and 1966, to increase the conveyance capacity of the river for flood control and navigation purposes. (2) the completion of the Ortona and Moore Haven Locks in 1937 (S-78 and S-77) to regulate the channel and lake (Okeechobee) stage, and (3) the completion of the Franklin Lock (S-79) in 1966 to maintain a freshwater head upstream and to limit the saline water front at the lock.

The surface water drainage system is hydraulically connected to the water table aquifer. It is considered that the shallow groundwater system is inseparable from the surface water system and, in the present analysis, is treated as a single hydrologic unit. The surface water, in this report, refers to that portion which emerges as surface water in the river, although its origin may be from shallow groundwater storage, surface water storage, direct storm runoff, or irrigation return flow.

SOURCES OF DATA

The sources of data are varied, and those of primary importance are:

1. Evaporation pan data at Belle Glade, Clewiston, and Moore Haven from the U. S. Weather Bureau.
2. Rainfall data from seven stations: (MRF6038, 7043, 6044, from the U. S. Weather Bureau; MRF5021, 5004, from the Florida Forestry Service; MRF250, 227, from SFWMD, Figure 1).
3. Discharge data at S-77, S-78, S-79, and the Townsend Canal from the U.S.G.S.
4. Groundwater level data from the U.S.G.S. (Figure 1).
5. Tributary flow data at Cypress Creek, Jack's Branch, Banana Branch, and Crawford Canal for the period 1978 to 1980 from the Data Management Division, SFWMD (Figure 1).

6. Geologic data from the SFWMD Technical Publication (82-1), Design Memorandum of the Caloosahatchee River (U. S. Army Corps of Engineers, 1957 to 1964), and from U.S.G.S. publications (Boggess and Missimer, 1975).
7. Land use data prepared by the Land Resources Division, SFWMD.
8. Public water withdrawal data from the Florida Department of Natural Resources and the SFWMD Water Use Division.

GENERAL DESCRIPTION

TOPOGRAPHY

A topographic map of the Caloosahatchee River Basin is shown in Figure 2. Figure 3 shows a north-south cross-section of the WCAL, and Figure 4 shows a longitudinal profile of the river channel. Generally, the ECAL has a milder relief than the WCAL, and in the vicinity of Lake Okeechobee, the terrain is nearly flat. The relief is generally steeper on the north side of the river than on the south side, reaching a maximum of 75 ft msl in the WCAL. The relief on the south side is nearly flat but steepens rather rapidly within a few miles towards the river. The south side of the river, in its natural state, was poorly drained with numerous sloughs and swamps. With the construction of numerous controlled drainage and irrigation canals, the drainage on the south side has been generally improved and the basin south of the river has become a highly developed agricultural area.

LAND USE

The land cover patterns of the ECAL and WCAL are shown in Table 1. Urban areas occupy about 1% in the ECAL and about 5% in the WCAL. Much of the urban areas are located adjacent to the river and are hydraulically connected to the surface water system. Although the percentage of urban area is small, the runoff generated from it may be proportionally significant both in terms of quantity and quality. The largest land use in the Caloosahatchee River Basin is agriculture which occupies about half the basin area. More than 80% of the agriculture area is used for cattle farming, with the remaining being used for truck crops, citrus, sugar cane, and other crops. Approximately half the basin area is undeveloped, consisting of rangeland and forested upland located in the north side of the basin, and wetlands located primarily in the south side of the basin.

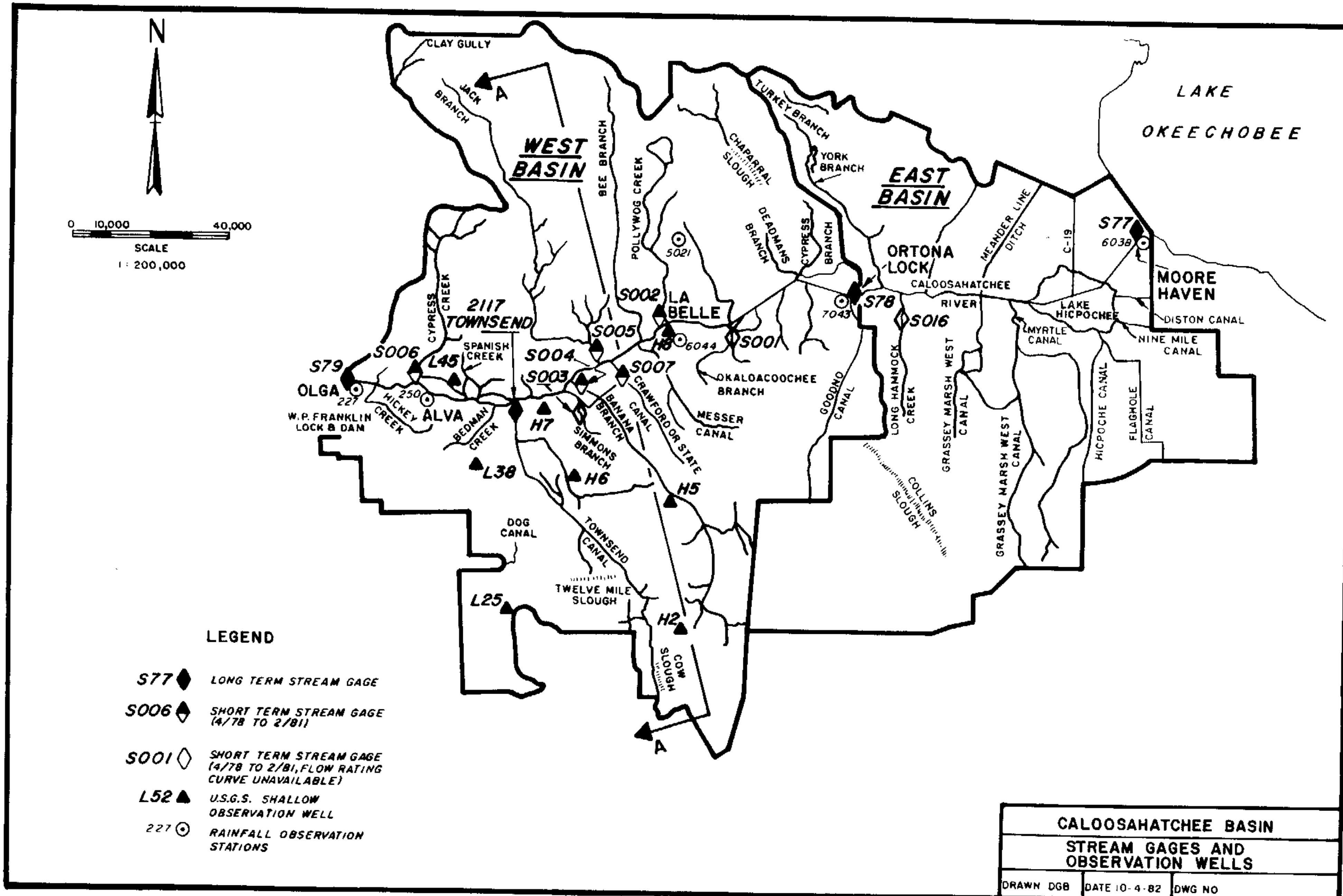


FIGURE I GAUGING STATIONS AND OBSERVATION WELLS

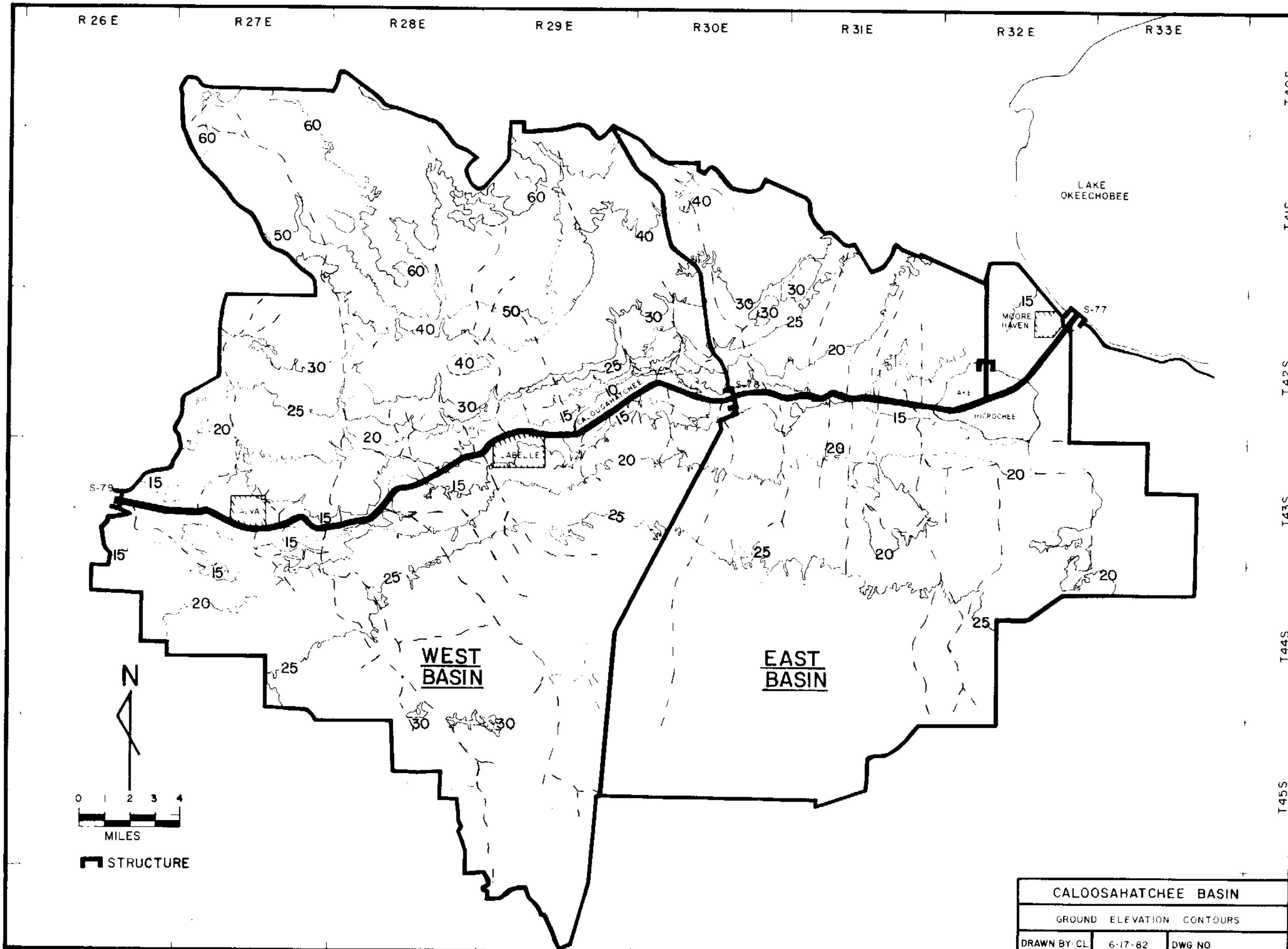
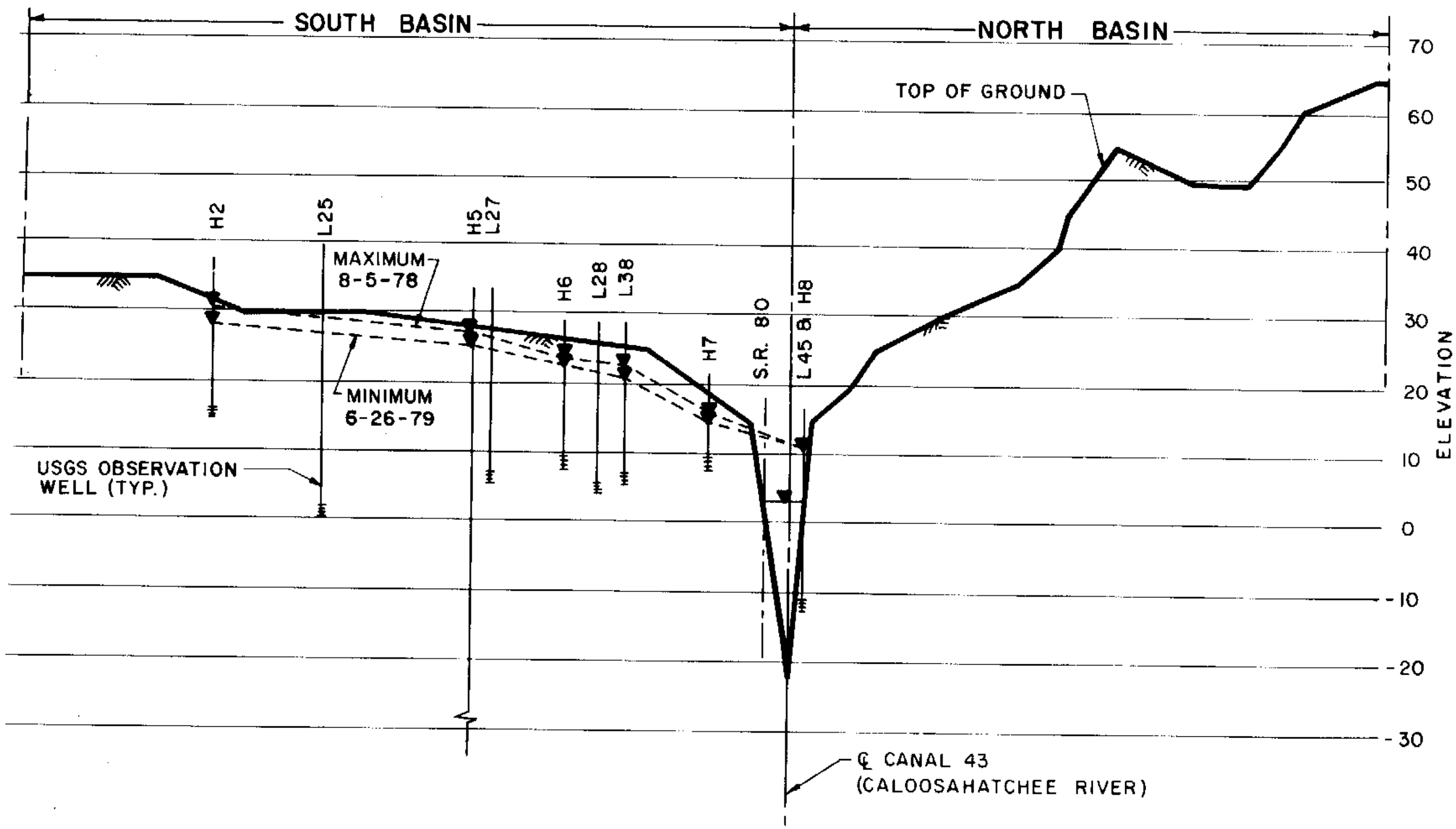


FIGURE 2 TOPOGRAPHIC MAP OF THE CALOOSAHATCHEE RIVER BASIN



NOTE: 1. SHALLOW OBSERVATION WELLS NOT AVAILABLE ON NORTH SIDE OF THE RIVER.
2. MAXIMUM AND MINIMUM WATER TABLE ELEVATIONS FOR THE PERIOD OF FEB. 2, 1978 TO JAN. 1, 1980.

SECTION A-A

(SECTION FROM FIGURE 1 AND 6)

FIGURE 3 NORTH-SOUTH SECTION OF [illegible]CAL

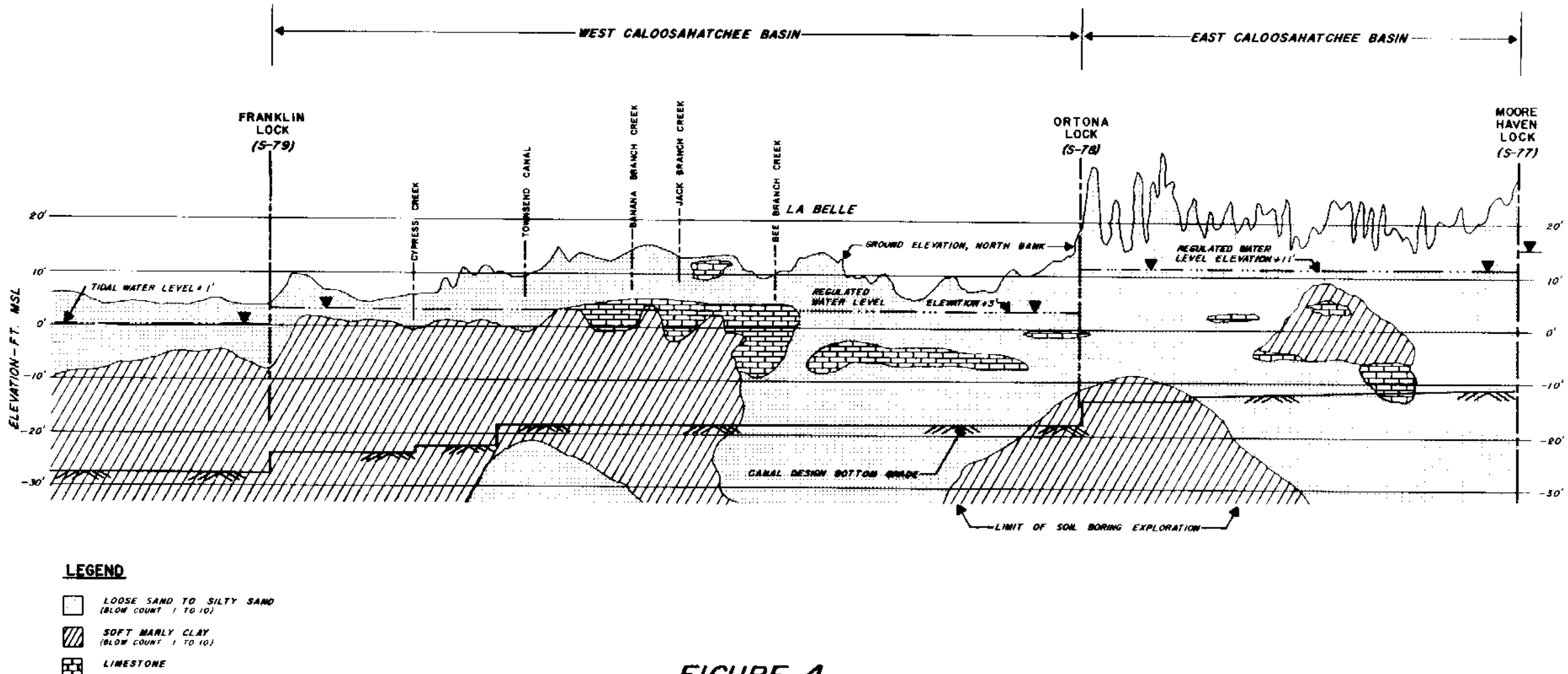


FIGURE 4

PROFILE OF THE CALOOSAHATCHEE RIVER
(FROM DESIGN MEMO., PART IV, CALOOSAHATCHEE RIVER (CANAL 43), CORPS OF ENGINEERS, 1964)

HORIZONTAL SCALE
0 10,000'

TABLE 1

Land Use Patterns
Caloosahatchee River Basin, 1981*

		ECAL (acres)	WCAL (acres)
I.	Urban and Built-Up Land	1,530 (1%)	18,993 (5%)
II.	Agriculture		
	Truck crop	2,000	2,315
	Citrus	3,000	29,119
	Sugar Cane	4,163	500
	Irrigated improved pasture**	66,614	63,814
	Non-irrigated improved pasture**	38,791	97,428
	Unimproved pasture	5,297	10,266
	Total Agriculture	119,865 (50%)	203,442 (54%)
III.	Native Areas (rangeland, forest, wet lands, etc.)	116,425 (49%)	157,565 (41%)
		237,820	380,000

* Based on 1978 land use from the Land Resources Division, SFWMD and Ray Burgess by personal communication.

** Various degree of improvement ranging from seedling alone to seedling, fertilizing and irrigation.

RAINFALL AND EVAPORATION

The mean annual rainfall for the basin is approximately 50 in. The mean annual evaporation from the basin, based on the mean evaporation data at Moore Haven and Belle Glade, and assuming a pan evaporation coefficient of 0.6, is approximately 40 in. Thus, the evapotranspiration (ET) loss represents approximately 80% of the rainfall. It also indicates that the mean annual yield of the basin is approximately 10 inches or 20% of the mean annual rainfall. However, for a more accurate assessment of the yield, the timing of the rainfall, demands and other factors must be taken into consideration.

A large portion of the surplus rainfall is released to the river as runoff by irrigation canals and natural streams during the wet season, while relatively little can be stored for use during the dry season. Rainfall in the Caloosahatchee Basin, therefore, is only slightly in excess of all the losses in a normal year and the basin is dependent on releases from Lake Okeechobee to supplement local demands during the drier months.

SURFACE WATER CONDITION

The tributaries of the Caloosahatchee River Basin and the gauging stations are shown in Figure 1. The drainage density (drainage length divided by drainage area) is considerably greater in the WCAL than in the ECAL. The greater drainage density in the WCAL is believed to be caused by the less porous soil and the steeper relief.

The largest tributaries include Cypress Creek, Jack's Branch, Banana Branch, Crawford Canal, Townsend Canal, C-19, Myrtle Canal, Flaghole Canal, and Diston Canal. There are other small tributaries not mentioned here that generally go dry during the dry season. Many canals and tributaries have control structures such as pump stations, gated spillways, or culverts with adjustable riser boards. These structures provide drainage during the wet months and allow water conservation during the dry months.

In general, tributary flows in the basin are complex due to the many controlled drainage systems that alter the natural flow pattern. Townsend, Flaghole, and Diston Canals are the largest canals in the basin. They convey relatively large flows to the river during the wet season and reverse the flow frequently by irrigation pumping during the dry periods. The surface flow pattern is often complicated by the existence of many irrigation wells and pumping facilites that alter the normal base flow to some tributaries, increasing, to a lesser extent, the base flow to some of the tributaries through irrigation return flow.

Historically, before the construction of the Franklin Lock, the river was affected by tidal changes as far east as Ortona. The mean low water stage at La Belle during that period was 0.1 ft msl. After completion of the Franklin Lock in 1966, the river stage between S-77 and S-78 has been maintained at 11 ft msl, and at 3 ft msl between S-78 and S-79. Thus, a fresh water head is maintained above the Franklin Lock reducing the intrusion of saline water. Furthermore, the river channel has been straightened and deepened considerably for the purposes of navigation and flood control. The portion of the river water above S-79 has become the major source of fresh water supply to metropolitan Lee County.

GROUNDWATER CONDITIONS

The SFWMD identified three major aquifer systems in the Caloosahatchee River Basin (Hydrogeologic Reconnaissance of Lee County, Florida, 1982). They are the Surficial, Hawthorn, and Floridan Aquifer systems. The general configuration of the aquifers is shown in Figure 5.

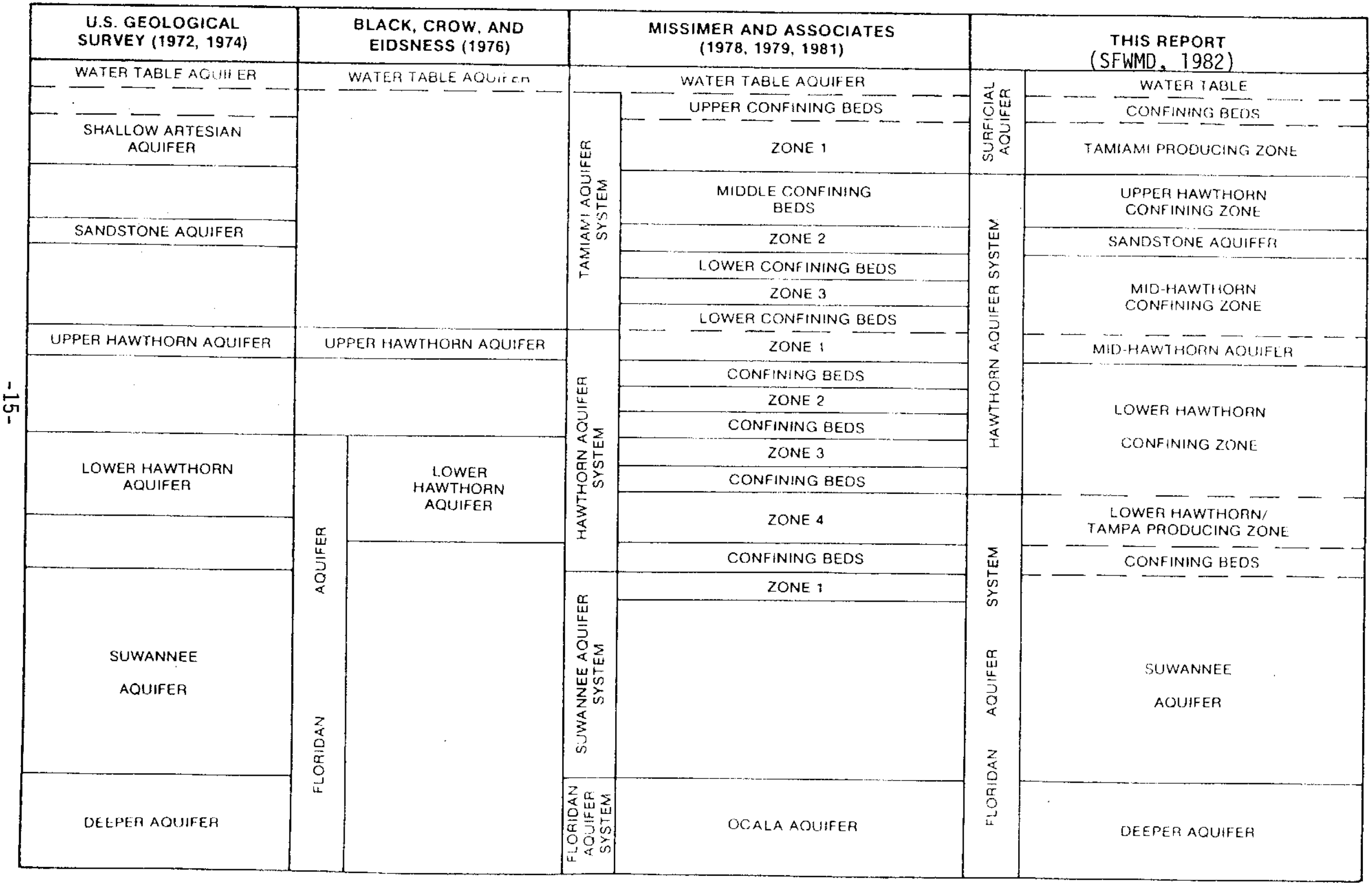


FIGURE 5 TYPICAL GEOLOGIC COLUMN (FROM TECHNICAL PUBLICATION 82-1, SFWMD)

The Surficial Aquifer is the uppermost water table aquifer, and consists of very loose, sandy, shelly material known as Pamlico Sand. The surficial sand is exposed to the surface in most parts of the Caloosahatchee River Basin except in the eastern portion around Lake Hicpochee where a layer of muck soil overlies the sand. As the sand is exposed to the surface, recharge from rainfall to the aquifer is quick and effective. Figure 3 shows a north-south section of the WCAL depicting the water table slope on the south side of the river. Figure 6 shows a water table contour map of the same area on August 5, 1978. Both figures indicate that the water table follows the land surface elevation, and the water table stage is consistently higher than the river stage. Thus, the Surficial Aquifer maintains low flows at the tributaries and discharges directly to the river. Recharge to the aquifer, on the other hand, is received mainly from local rainfall within the basin.

The Hawthorn Aquifer system consists of an upper Sandstone Aquifer and a lower Mid-Hawthorn Aquifer. The Sandstone Aquifer is separated from the Surficial Aquifer above by a layer of soft calcarious clay known as Buckingham Marl. The Buckingham Marl is semi-impervious and is absent in some locations; as such, its connection to the Surficial Aquifer is apparent. The Sandstone Aquifer probably receives most of its recharge from the Surficial Aquifer as its potentiometric surface is slightly below the water table elevation in most inland areas. The Mid-Hawthorn Aquifer that lies below the Sandstone Aquifer consists of fractured limestone, dolomite, and sandstone. Its potentiometric surface is slightly higher than the water table elevation, and its recharge is probably due to leakages from the deeper aquifers below.

The Floridan Aquifer system consists of the deeper limestone aquifers including the Lower Hawthorn and the Suwanee Aquifers. The potentiometric surface of the Floridan Aquifer system is approximately 20 to 30 feet above

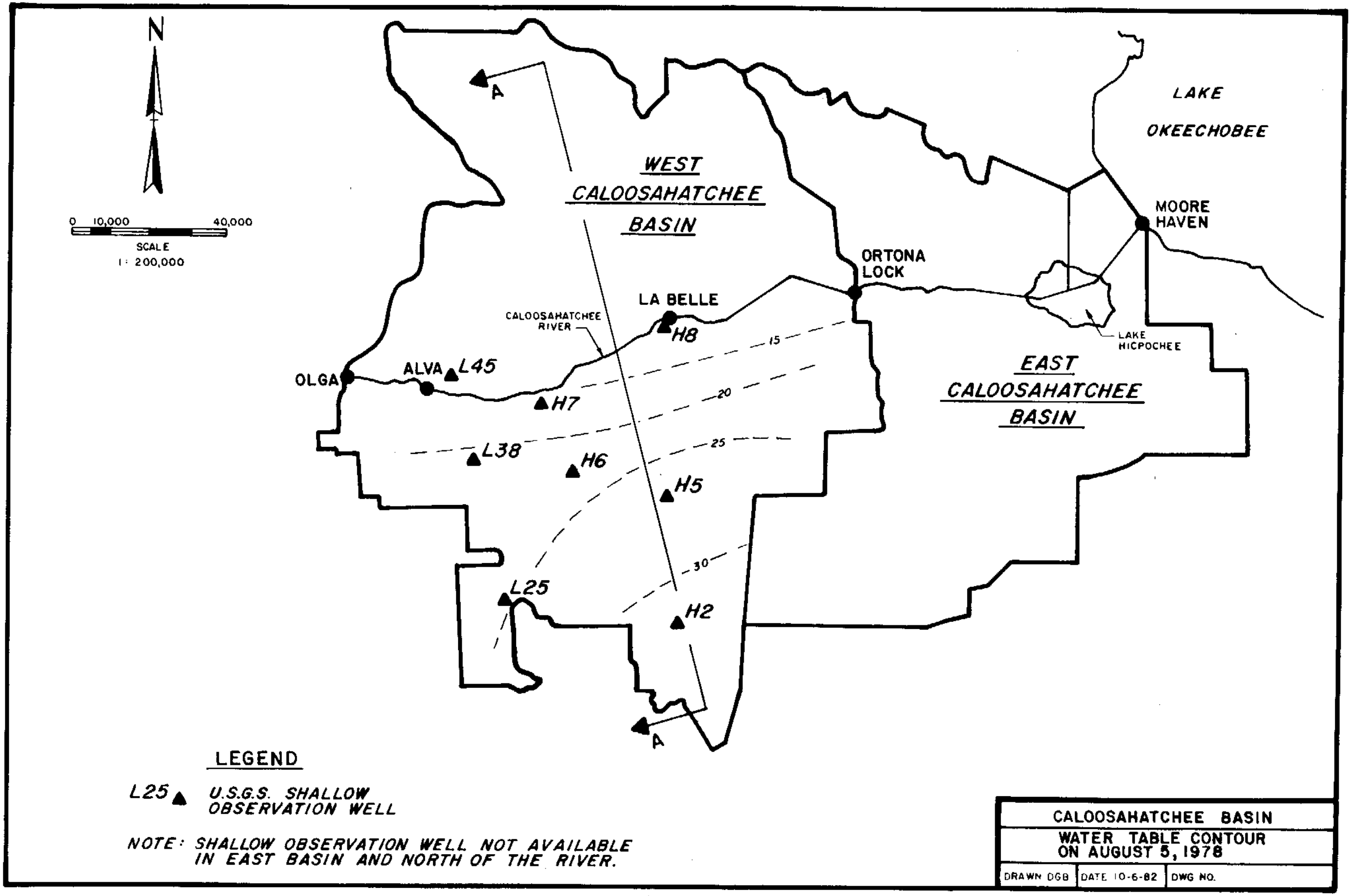


FIGURE 6 WATER TABLE CONTOUR ON AUGUST 5, 1978

the land elevation; as such, it is under highly artesian conditions. Recharge to the Floridan Aquifer system is from the high areas north of Lake Okeechobee, mainly in Polk County where, the aquifer crops out. Hydraulic connection to the upper aquifers in the Caloosahatchee River Basin is probably small, as the upper confining layer is relatively thick and impervious.

Much of the groundwater supply in the basin is obtained from the Surficial, Sandstone, and Mid Hawthorn Aquifers where the water is generally of good quality. Relatively little is obtained from the deeper aquifers where the water is highly mineralized. Leakage from the deeper aquifers to shallow wells through the aquitard and abandoned deep wells, however, is evident from the high chloride content in some localized areas.

During the design phase of the Franklin Lock and C-43, a large number of shallow (less than 100 feet) soil borings were drilled by the Corps of Engineers along the banks of the river (Design Memorandum, Part IV, Caloosahatchee River and Control Structures, U. S. Army Corps of Engineers, 1957 and 1964). The geologic profile of the Caloosahatchee River obtained from such an exploration program is redrawn in Figure 4.

Assuming that the geologic profile depicted in Figure 4 is generally representative of the entire Caloosahatchee River Basin, it would indicate that the ECAL is covered with a much thicker layer of surficial sand than the WCAL. Therefore, the ECAL is more porous and this may explain the fact that the ECAL has a smaller drainage density.

LOCAL INFLOW ANALYSIS

The daily local inflow hydrograph to the Caloosahatchee River from the ECAL is plotted in Figure 7 for the periods of 1977 and 1978. The local inflow from the ECAL was computed as the difference of the discharges at S-78 and S-77 after adjustment of the channel precipitation and evaporation.

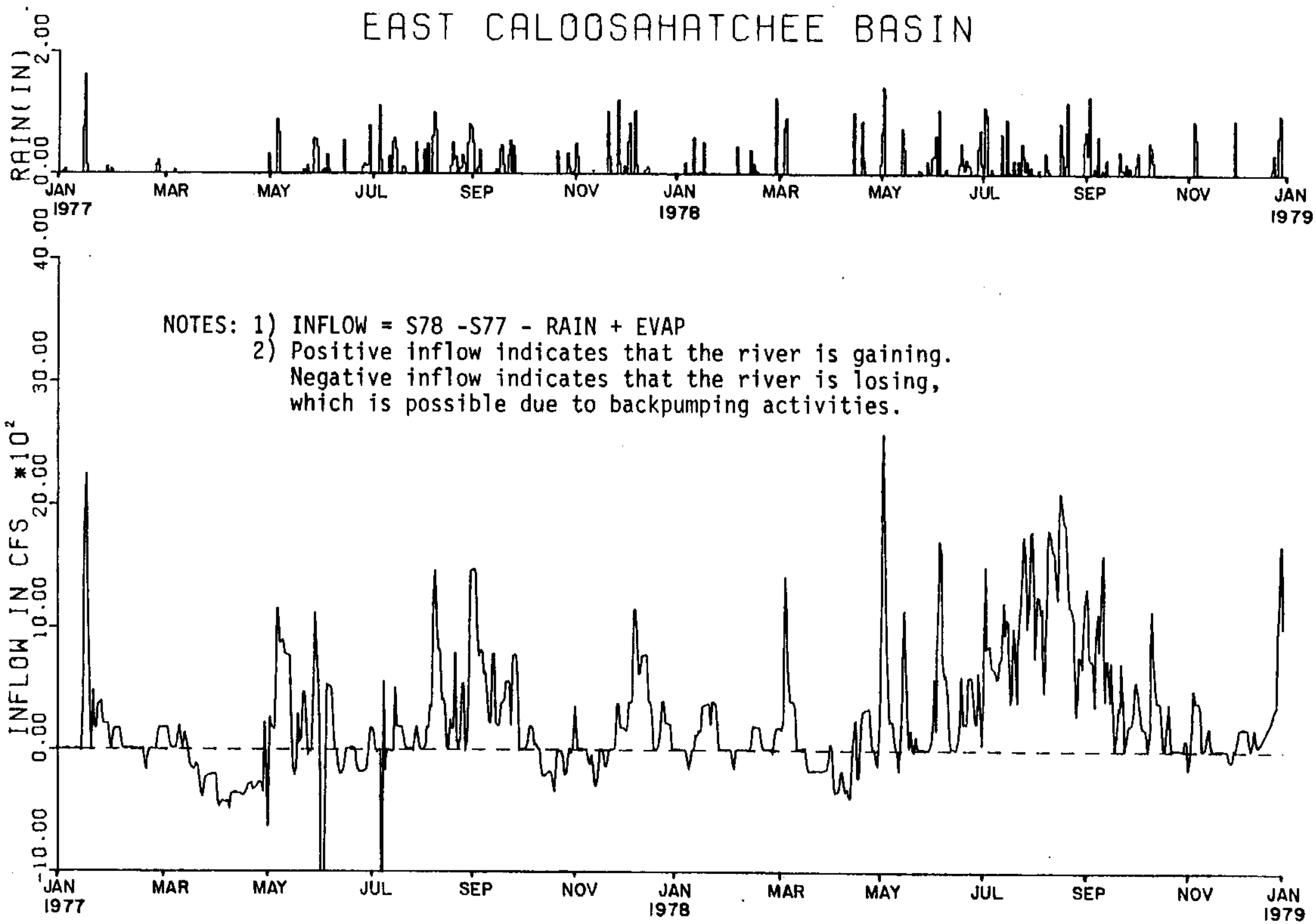


FIGURE 7
Daily Local Inflow Hydrograph, ECAL

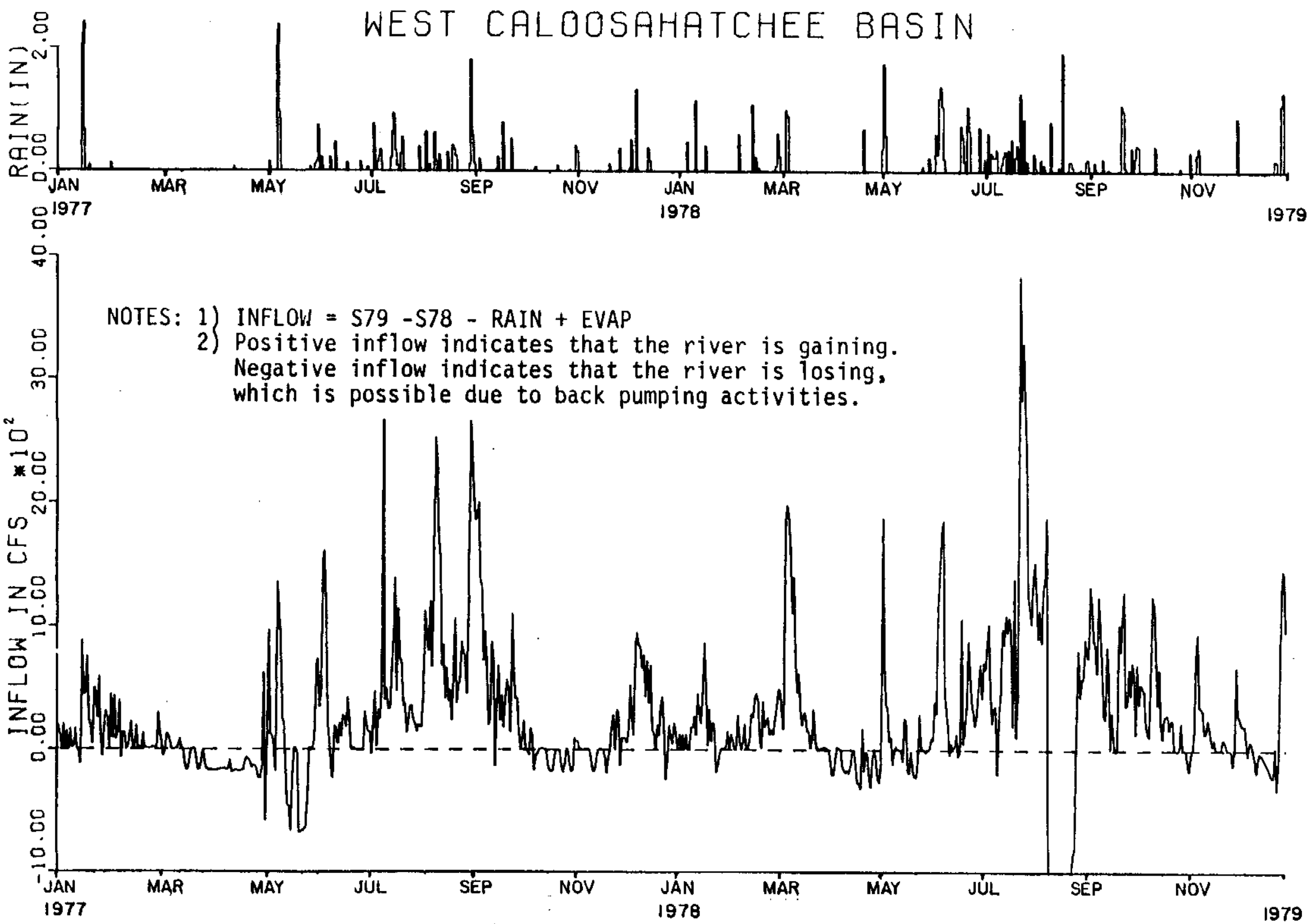


FIGURE 8
Daily Local Inflow Hydrograph, WCAL

Channel storage variation is ignored since the regulation schedule maintains the river stage at a nearly constant level throughout the year. Using a similar approach, the local inflow from the WCAL was computed and plotted in Figure 8.

The outflow hydrograph of a basin reflects the hydrogeologic characteristics of the basin. A basin of large flow attenuation capacity tends to generate hydrographs with a smooth shape. The flow attenuation capacity of a basin is directly proportional to the size of the basin, the flatness of the topography, and the extent of the surface water and groundwater storage. Despite the fact that the ECAL is only two-thirds the size of the WCAL, the local hydrograph of the ECAL is considerably smoother than that of the WCAL (compare Figures 7 and 8). This may be explained by the fact that the ECAL has a flatter topography, a greater portion of the land covered with wet land, and a thicker layer of sand overlying the basin.

Five major tributaries in the WCAL were gauged by the District between 1978 and 1980 (Figure 1). Discharge data from these tributaries were used to prepare a water budget of the local inflows in the WCAL. The water budget is summarized in Table 2 below. The detailed water budget is shown in Table 3.

TABLE 2

Percentage Distribution of Local Inflows
WCAL 1978 to 1979

	Mean Monthly Inflow to River	Tributary Flows			Residual*
		North of River	South of River	Total	
Wet Season (May-Oct.)	100% (38,039 AF)	18%	34%	52%	48%
Dry Season (Nov.-April)	100% (27,837 AF)	24%	31%	55%	45%

*Residual term consists of groundwater seepage and errors of tributory flow components. If it is assumed that the tributary flow data are within 15% error, the groundwater seepage term would amount to about 32% to 62% of the total inflow.

		JACK'S BRANCH	CYPRESS	TOTAL NORTH		CRAWFORD	BANANA	TOWNSEND	TOTAL SOUTH					
DATE	INFLOW	S005	S006	NFLOW	%	S007	S004	S2177	SFLOW	%	SEEPAGE	%	RESIDUAL	%
5-15-78	4901.	149.	681.	1576.	32.	5709.	1032.	-5208.	10296.	210.	2140.	44.	-9111.	-186.
6-15-78	24553.	489.	749.	2352.	10.	1143.	1270.	3898.	9447.	38.	2140.	9.	10615.	43.
7-15-78	63217.	3124.	760.	7379.	12.	1720.	2674.	12052.	22158.	35.	2140.	3.	31541.	50.
8-15-78	-12390.	3590.	1711.	10072.	-81.	1603.	2587.	13527.	23164.	-187.	2140.	-17.	-47765.	386.
9-15-78	39650.	1612.	527.	4063.	10.	1680.	1845.	1190.	7918.	20.	2140.	5.	25529.	64.
10-15-78	23045.	470.	698.	2220.	10.	676.	3290.	-363.	8759.	38.	2140.	9.	9926.	43.
11-15-78	7235.	60.	777.	1590.	22.	1055.	715.	-1434.	2638.	36.	1800.	25.	1208.	17.
12-15-78	10034.	0.	770.	1464.	15.	1543.	679.	3105.	8218.	82.	1800.	18.	-1448.	-14.
1-15-79	23075.	5040.	7941.	24663.	107.	2166.	2686.	13712.	24734.	107.	1800.	8.	-28123.	-122.
2-15-79	14508.	2169.	1227.	6453.	44.	856.	1486.	-2727.	2660.	18.	1800.	12.	3596.	25.
3-15-79	6177.	1032.	630.	3159.	51.	1543.	821.	-3413.	2025.	33.	1800.	29.	-807.	-13.
4-15-79	-1225.	39.	560.	1176.	-96.	1320.	734.	-7914.	-3190.	260.	1800.	-147.	-1011.	83.
5-15-79	-15580.	212.	496.	1344.	-9.	1778.	2268.	4747.	14052.	-90.	2140.	-14.	-33116.	213.
6-15-79	5762.	102.	486.	1116.	19.	1292.	1214.	-4058.	1706.	30.	2140.	37.	800.	14.
7-15-79	16356.	119.	547.	1266.	8.	1292.	1265.	6456.	12338.	75.	2140.	13.	612.	4.
8-15-79	10499.	197.	612.	1537.	15.	643.	2390.	-4759.	2216.	21.	2140.	20.	4606.	44.
9-15-79	150672.	7106.	7775.	28275.	19.	702.	4368.	25944.	37604.	25.	2140.	1.	82654.	55.
10-15-79	128202.	6500.	8697.	28875.	23.	805.	7545.	6579.	25784.	20.	2140.	2.	71403.	56.
11-15-79	27822.	912.	5686.	12536.	45.	857.	3670.	343.	10756.	39.	1800.	6.	2730.	10.
12-15-79	51113.	545.	6159.	12739.	25.	935.	4038.	6579.	18016.	35.	1800.	4.	18563.	36.
1-15-80	43165.	156.	609.	1452.	3.	962.	2238.	301.	7708.	18.	1800.	4.	32205.	75.
2-15-80	59538.	305.	562.	1647.	3.	691.	2714.	794.	8624.	14.	1800.	3.	47467.	80.
3-15-80	46390.	328.	622.	1804.	4.	1117.	2019.	-1113.	6100.	13.	1800.	4.	36687.	79.
4-15-80	46203.	21.	497.	985.	2.	712.	1172.	-2797.	1538.	3.	1800.	4.	41881.	91.
5-15-80	30780.	22.	472.	937.	3.	1374.	1117.	-3044.	2685.	9.	1800.	4.	25018.	81.
6-15-80	5439.	0.	448.	851.	16.	1197.	728.	-13150.	-8724.	-160.	2140.	39.	11172.	205.
7-15-80	23569.	0.	560.	1064.	5.	1726.	2040.	3456.	12116.	51.	2140.	9.	8249.	35.
8-15-80	49564.	1027.	556.	3008.	6.	1976.	2790.	9408.	20371.	41.	2140.	4.	24045.	49.
9-15-80	98422.	6121.	3615.	18499.	19.	1811.	3930.	7795.	20998.	21.	2140.	2.	56785.	58.

EXPLANATION
ALL FLOWS IN AF OR % OF INFLOW
INFLOW=S79-S78+EVAP-RAIN, NET BASIN INFLOW TO RIVER
NFLOW=(S005+S006)*1.9, TRIBUTARY FLOW FROM NORTH OF BASIN
SFLOW=(S007+S004)*2.3+S2177, TRIBUTARY FLOW FROM SOUTH OF BASIN
SEEPAGE,DIRECT SEEPAGE FROM NORTH AND SOUTH BASIN ESTIMATED
FROM DARCY EQUATION
RESIDUAL=INFLOW-NFLOW-SFLOW-SEEPAGE, INCLUDING ALL UNGAGED
FLOWS SUCH AS OVERLAND FLOW,PUMPAGE,...ETC.

TABLE 3 TRIBUTARY INFLOW WATER BUDGET

The drainage area of the gauged tributaries covers approximately 60% of the total basin area of the WCAL. The discharges of the ungauged tributaries must be estimated. In the present analysis, the discharges of the ungauged tributaries were estimated from the discharge data of the gauged tributaries by a drainage area ratio method. Other components of the water budget such as seepage, overland flow, and pumpage cannot be determined with any certainty because of the lack of data and, therefore, are included in the residual term.

Table 2 indicates that the tributary inflows from the south side of the river are greater than those from the north side of the river, and the differences are greater during the wet season than in the dry season. Since the drainage areas on both sides of the river in the WCAL are almost equal, it suggests that the more numerous drainage canals south of the river have the effect of increasing the tributary outflow during the wet season, whereas irrigation practice during the dry season tends to reduce it.

The residual term shown in Table 2 is relatively large, representing almost 47% of the total inflow to the river. Assuming direct overland runoff to the river is generated within one-half mile of the river, the contribution of water from direct overland flow is small (less than 5% using a runoff coefficient of 0.3) due to the effective interception by the tributaries. This suggests that the residual term is comprised mainly of groundwater seepage and errors of the tributary flow data. If it is assumed that the tributary flow data are within a 15% error rate the total groundwater seepage term would range from 32% to 62% of the total inflow.

One should be cautious that the local inflow analysis was based on a short period of record between 1978 and 1979. Furthermore, the analysis was based on the inflow data from the WCAL, as similar data were lacking in the ECAL. For these reasons, the local inflow distribution may be quite different for the ECAL and for other periods.

BASIN YIELD

GENERAL

The yield of a basin can be defined in various ways depending on the situation of the basin. The yield of the Caloosahatchee River Basin is defined here as a portion of the estimated natural local inflow to the river that can be allocated for beneficial use without producing undesirable effects.

Only a portion of the total inflow to the river is considered the yield, as a certain amount of minimum flow must be released to the river to minimize the undersirable effects. Only the local inflow is included. The supplemental release from Lake Okeechobee is not considered as a portion of the yield because the lake storage is also shared by other parts of south Florida. Because human activities have altered the natural flow pattern, the natural local inflow is unknown and must be estimated .

In order to assess the water availability of a basin, it is necessary to quantify the yield. It is not sufficient to quantify the annual yield alone it is also important to quantify the time and spatial distribution of the yield. Furthermore, it is equally important to quantify, to the same extent, the consumptive demand of the basin that must be met by the yield.

In the present approach, the basin was divided at Ortona Lock (S-78) into an East Caloosahatchee Basin (ECAL) and a West Caloosahatchee Basin (WCAL). The yields of the basin for the period of 1966 to 1980 were computed by a water balance method considering all inflows and outflows to and from the river channel. The consumptive demand of the basin was estimated from the pumpage records of water companies and from the Soil Conservation Service TR-21 method for irrigation water demand. The estimated yields and demands were treated with various statistical techniques. The yield and demand relationship for different frequencies, durations, and months of a year were depicted.

For clarity of the discussion to follow, several important terms used are defined below:

Surface Water - The quantity of water that emerges as surface water at the river regardless of its origin.

Water Withdrawal, Pumpage - The quantity of raw water that is pumped or diverted from surface or groundwater bodies.

Return Flow - The portion of the water withdrawn that is returned to the natural or groundwater system.

Water Use, Demand, Consumptive Demand - Quantity of water that is actually consumed. It is equal to the quantity withdrawn less the quantity of return flow. In irrigation, it is essentially equal to the evapotranspiration (ET) of a crop under optimum growth condition.

PUBLIC WATER WITHDRAWAL

There are five major water utility companies (two surface water and three groundwater) that withdraw water from the Caloosahatchee Basin. Four of the water companies are located in the WCAL and one in the ECAL. The pumpage data between 1975 to 1980 are shown in Table 4. The data were obtained from pumpage records furnished by the Department of Natural Resources and the Resource Control Department, SFWMD.

The largest withdrawals are taken from the Caloosahatchee River upstream of S-79 to supplement the water demands of the City of Fort Myers and western Lee County. The other three water companies supply water to Lehigh Acres, La Belle and Moore Haven, all of which withdraw water from the shallow groundwater aquifer.

The public water withdrawal in the ECAL is small and has remained relatively constant for the past 10 years. Assuming that 45% of the water is consumed (typical of United States urban water consumption), the public water demand amounts to less than 1% of the total water use in ECAL in 1980.

The public water withdrawal in the WCAL is much larger due to heavy withdrawal of the river water above Franklin Lock to supplement the demand in metropolitan Lee County. Moveover, since the sewage treatment plants are located below Franklin Lock, none of the unconsumed water returns to the WCAL. It can, therefore, be assumed that 95% of the water withdrawn is consumed. Accordingly, the public water use in the WCAL in 1980 amounted to 27% of the total water use. The public water use has also increased steadily due to the population expansion in the western portion of Lee County. If the present trend continues, the public water use in the WCAL will double in approximately eight years.

In the water balance analysis, a linear equation was fitted to the public water withdrawals. Withdrawal prior to 1975 was extrapolated from the linear equation. Consumptive use was assumed, as explained above, to be 45% and 95% for the ECAL and WCAL, respectively.

TABLE 4

Public Wataer Withdrawal in MGD
(Department of Natural Resources)

Water Company	1975	1976	1977	1978	1979	1980
City of La Belle	.066	.225	.318	.318	.327	.382
City of Fort Myers	4.610	5.131	5.936	6.205	7.139	7.789
Lehigh Acres	.586	.643	.850	.875	.787	.841
Lee County	2.683*	3.165*	3.696	4.141	4.445	5.203
Moore Haven	.194*	.197*	.200*	.203	.224	.204
Total WCAL	7.943	9.163	10.8	11.539	12.698	14.215
Total ECAL	.194*	.197*	.200	.203	.224	.204

*Estimated

IRRIGATION WITHDRAWALS

Whereas the public water demand is rather constant or increases steadily, the irrigation demand fluctuates considerably from month to month, depending upon the availability of rainfall to satisfy the evapotranspiration demand (ET). An exact quantification of the irrigation demand is not possible due to the lack of pumpage records and the many factors involved. An indirect estimation method must be used.

The Soil Conservation Service TR-21 (1967) method was used to estimate the irrigation demand. The TR-21 method can be divided into two major steps: 1) the crop ET demand was estimated by the Blaney-Criddle Method; 2) the amount of rainfall effective in satisfying the ET demand was estimated by the SCS effective rainfall formula. The non-negative difference of the ET demand and the effective rainfall is the irrigation requirement.

Since local lysimeter studies of crop demands were available, local data were used to estimate the ET demand directly. The ET demand for citrus, pasture, truck crops and sugarcane in South Florida are shown in Table 5. The data were compiled from the results of several lysimeter studies in South Florida conducted by various researchers. The ET demands represent the quantity that would result in optimum growth of the crop. In the Caloosahatchee Basin, the improved pasture rarely obtains optimum irrigation application; therefore, in computing the ET demand for the improved pasture, only one-third of the ET demand was assumed to be effective. For the purpose of simplifying the computation, a composite ET demand of all crops was derived based on the weighted average of the ET demand of all crops in the Caloosahatchee Basin. The composite ET demand was applied to the total irrigated acreage to obtain the actual ET demand.

TABLE 5

Consumptive Demand (ET) of Major Crops

	Citrus/Pasture(1) (in.)	Truck Crops(2) (in.)	Sugarcane(3) (in.)
January	2.1	2.7	1.4
February	2.6	2.7	1.1
March	3.6	3.4	2.5
April	4.5	3.7	3.4
May	5.3	0.0 (4)	4.8
June	4.4	0.0 (4)	6.0
July	4.9	0.0 (4)	6.5
August	4.8	0.0 (4)	6.7
September	4.0	0.0 (4)	5.1
October	3.6	3.5	5.2
November	2.7	2.9	3.2
December	2.1	2.6	2.6
Total	44.6	21.5	48.5

(1) Combined data from research at Soil, Water, Atmosphere, and Plant Project in Fort Pierce, and lysimeter data at the Agricultural Research Service in Fort Lauderdale.

(2) Data extrapolated from WRC-2 paper, Water Resources Council, University of Florida as an average for all vegetables.

(3) ASAE paper 79-2095, S. F. Shih, Everglades Experimental Station presented in June 1979.

(4) Truck crops are not grown in south Florida during the summer months.

The total irrigated acreage for 1957, 1972, 1978 is shown in Table 6, and a linear equation was fitted to the acreage shown in Table 6 for interpolation of the irrigated acreage in intervening years.

TABLE 6

Total Irrigated Acreage*

Year	1957	1972	1978
ECAL	2,900	69,800	75,800
WCAL	4,300	84,900	95,000

*Prepared by the Land Resources Division, SFWMD.

The portion of the rainfall that is effective in satisfying the ET demand is defined in the TR-21 procedure as the effective rainfall. The effective rainfall depends on the quantity and timing of the rainfall and the ET demand. The following is an effective rainfall formula, developed by the Soil Conservation Service from field and laboratory studies:

$$RE = (0.70917RT^{0.82416} - 0.11556)(10)^{0.02426ET}$$

where RE = Effective rainfall in inches

RT = Total rainfall in inches

ET = Consumptive demand of crop in inches

The above equation assumes that the irrigation application depth is 3 in. and that any surplus rainfall will be lost in deep percolation or runoff. The positive difference between the ET demand and the effective rainfall is the estimated irrigation demand.

MINIMUM FLOW REQUIREMENT

As previously stated, the basin yield is defined as that portion of the estimated natural inflow which can be allocated for beneficial use without producing undesirable effects. Certain minimum flow (and/or minimum stage) must be released to the river in order to minimize the undesirable effects. The concerns for the Caloosahatchee River are varied:

1. The water between S-79 and the Lee-Hendry County line must be of Class I-A quality (FDER Water Quality Standard classification) to supply potable water to metropolitan Lee County.
2. The water east of the Lee-Hendry County line and in all tributaries should be of Class III water to maintain a balanced fish and wildlife ecology, recreational value, and to supplement irrigation demand.
3. The river must maintain sufficient depth for navigation and to reduce salt water movement upstream.
4. There must be sufficient fresh water release from Franklin Lock to maintain a balanced estuarine ecology downstream.

The minimum stage has been established by the Corps of Engineers as the regulation stage of 3 ft msl between S-78 and S-79, and 11 ft msl between S-77 and S-78. The regulation stage was established mainly on the basis of maintaining a fresh water head at S-79 to minimize saline water intrusion and to provide sufficient depth for navigation.

A minimum flow criterion at the river, based on water quality and environmental concerns, has not been established officially; however, it is difficult and probably not advisable to establish one. The quality of the river water is not a simple function of the rate of flow, but is dependent upon many factors such as the time of the year; the temperature; the change in land use and cultural practices; the variation of the relative contribution from rainfall, seepage, tributary inflow, and Lake Okeechobee releases. In the past, releases from Lake Okeechobee were made to flush the river whenever an algal bloom occurred or whenever the salinity had risen to an intolerable level. Moreover, releases from Lake Okeechobee and Franklin Lock were made regularly for lockages and for regulating the lake and river stages. These periodic releases appear to be adequate enough to control the water quality condition; therefore, establishing a mandatory minimum flow at the river would seem to be unnecessary.

Under critical drought conditions, lockages in the river will be suspended and the gates at S-79 will be closed. Certain minimum flow, however, must enter the river to maintain the regulation stage. The minimum flow requirement under such a drought condition is equal to the loss in the river due to evaporation in the channel and leakages at the gates and locks. Accordingly, the losses in the eastern and western portions of the river can be estimated at 300 and 800 ac/ft per month. These values were established as the minimum flow requirements for the Caloosahatchee River in this study.

It should be emphasized that the minimum flow requirements established here are simply a criterion used for the purpose of estimating the basin yield. As different from the regulation stage, this minimum flow requirement is not a recommended regulatory release to the river, but refers to the local inflow to the river, including seepage and other uncontrollable inflows.

COMPUTATION OF THE BASIN YIELD

Computation of the basin yield is based on a monthly water budget of the inflows and outflows to and from the river channel. The period chosen is from 1966 to 1980 when the present configuration of the river was evolved.

The local inflow to the river was computed by the following equations:

For ECAL: Inflow = S78 - S77 - Rain + Evap (1)

For WCAL: Inflow = S79 - S78 - Rain + Evap (2)

Where : S79, S78, and S77 are the discharges at Franklin, Ortona, and Moore Haven Locks, respectively. Rain and Evap are channel precipitation and evaporation, respectively.

Discharge data for S-78 are available only after June 1971. Discharge data prior to June 1971 for S-78 were estimated. A stepwise regression analysis was used to correlate the discharge at S-78 with the discharge at S-77, discharge at S-79, precipitation and evaporation at the channel, and the estimated pumpage. The regression analysis indicates that the discharge at S-78 is highly correlated with the discharges at S-77 and S-79, but has virtually no correlation with the other components. Thus, the discharge data at S-78 were extended for the missing period by a linear multiple regression equation with the concurrent discharges at S-77 and S-79. The multiple correlation coefficient for the above regression equation is 0.991.

The channel precipitation was obtained as the arithmetic mean of four rainfall stations near the river. The channel evaporation was obtained as the arithmetic mean of the pan evaporation data at Moore Haven and Belle Glade using a pan coefficient of 0.75. The channel precipitation and evaporation are generally insignificant compared with the other water budget components. However, during low flow periods, they may turn out to be in the same order of magnitude as the other components.

The channel storage variation was neglected in the water budget equation. It was assumed that the storage change was negligible due to the fact that the channel stage is regulated at a nearly constant level at all times. However, occasionally there were large releases from Lake Okeechobee to regulate the lake stage and control the salinity or algal bloom at the river. Such large releases occurred infrequently (six occurrences between 1973 and 1979), and each time a large release lasted for less than a week. On a monthly water budget, it is considered that such a release has little effect except when it occurs at the beginning or the end of a month.

The inflow computed from equation (1) or (2) refers to the actual inflow to the river in ECAL and WCAL, respectively, under the existing conditions. This actual inflow includes the effects of all human activities such as groundwater and surface water pumpage and diversion activities. The estimated natural inflow, here defined as the hypothetical inflow under a hypothetical condition when all the consumptive demands were reduced to zero, equals the actual inflow plus the demand adjustment. The basin yield equals this estimated natural inflow minus the minimum flow requirement:

Yield = Estimated natural inflow (Actual inflow + Demand adjustment)
- Minimum flow requirement (3)

The demand adjustment was computed here simply as the estimated total consumptive demand in the basin. It is realized that the total consumptive demand is not exactly the same as the demand adjustment. Major discrepancy lies in the fact that the total consumptive demand effect of the inflow to the river is not instantaneous, but is attenuated over a long period by the storage effect of the basin. Differences in local drainage and irrigation practices may also modify the effect. Since it is difficult to quantify these factors, the demand adjustment is simply computed as the estimated total consumptive demand. The errors introduced with such an assumption are probably random, and when the yields are treated statistically, the errors tend to cancel one another.

The detailed water budgets of the basin yields are tabulated in Table 7. The yields and demands were plotted chronologically in Figure 9. In order to magnify the detail of the yield and demand relationship during the dry periods, the plot in Figure 9 was scaled in such a way that the yields were cut off at an arbitrary upper limit.

As shown in Figure 9, the yields and demands are quite variable. Generally, low yields coincide with high demands. The variability of the total demand is explained primarily by the variability of the irrigation demands, as irrigation accounts for over 70% of the total water use.

The basin yield computed by the present approach may turn out to be negative in certain dry months. Negative yield represents the amount of supplement from upstream of the basin (Lake Okeechobee to ECAL or Ortona Lock to WCAL). The ECAL was under deficient or negative yield conditions more frequently due to the fact that pumping and diversion activities were practiced more extensively in the ECAL.

STATISTICAL ANALYSIS OF BASIN YIELD AND DEMAND

Because of the variability of the yields and demands, it is necessary to know the time distribution of both quantities so that the yield and demand condition of the basin can be correctly interpreted. For this purpose, the yields and demands were analyzed by frequency analysis for different durations and for different months of the year.

One basic requirement for frequency analysis is that the sample of data must be statistically stationary; that is, the data must be time independent. Since the estimated yields include the consumptive demand effect, the yields

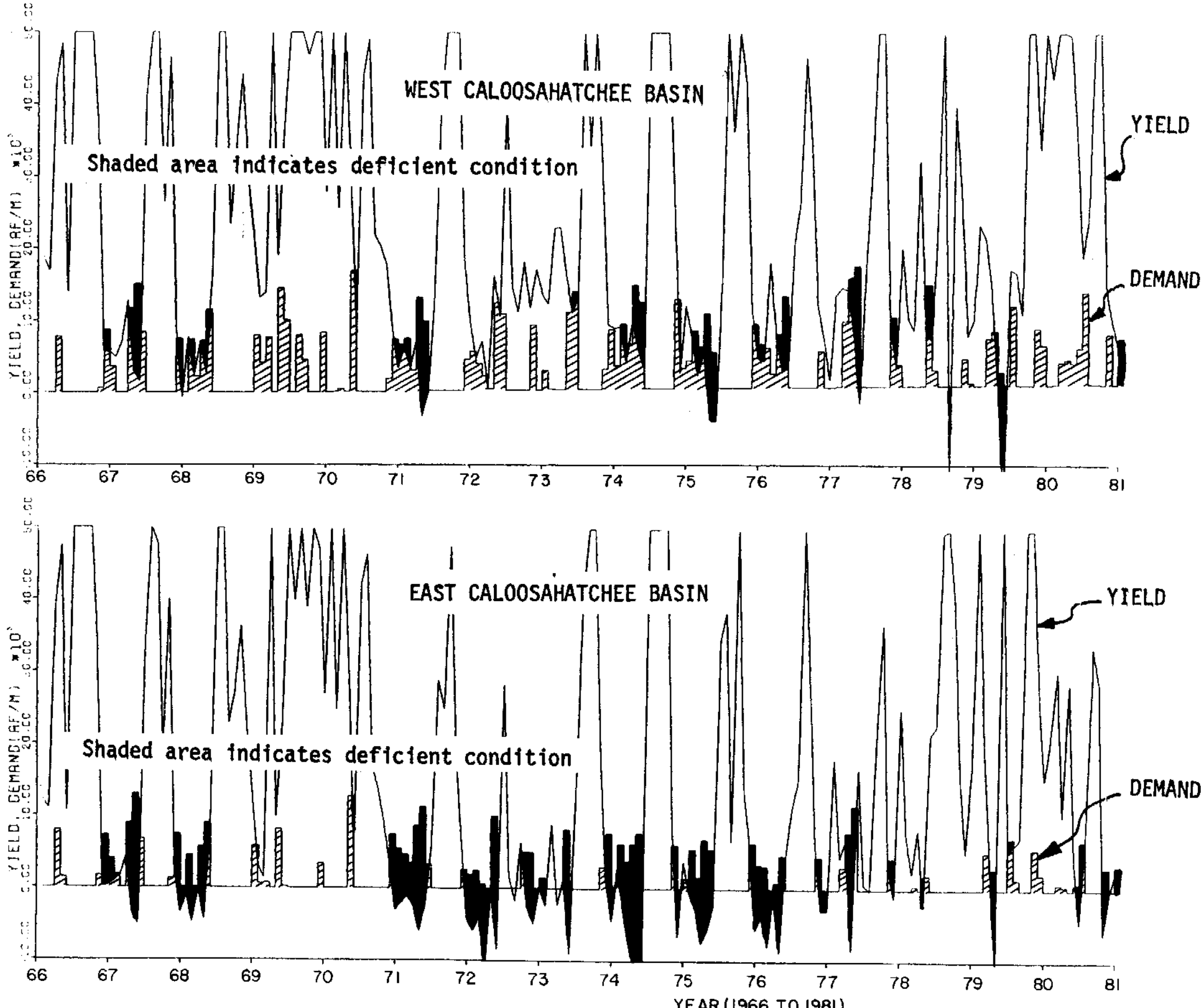


FIGURE 9
Basin Yield and Demand Hydrographs

can be assumed to be approximately time independent with respect to the land use change. A similar assumption for the demands, however, is inapplicable.

Public water demand follows a predictable trend and, therefore, frequency analysis of its distribution is unnecessary. Irrigation water demand, on the other hand, varies substantially. In order to analyze the irrigation water demand statistically, it is necessary to remove the time effect due to land use change. It is difficult to quantify the time effect exactly as it depends on many factors. For simplicity, it is assumed that the time effect is explained entirely by the irrigated acreage. Thus, if the irrigation demand is expressed in inches per irrigated area, it is approximately time independent and, therefore, lends itself to conventional frequency analysis.

A. Frequency - Duration Curves

1. The yield-frequency-duration curves and demand-frequency-duration curves were plotted on Gumbel Extremal Probability Paper in Figures 10 through 13. Straight lines were fitted manually to the data points. Mathematical least square fitting is considered inappropriate due to the short length of record and the relative significant effect of a few outliers. The extreme values at both ends were given less weight due to probable errors in the water budget.
2. Annual minimum yield of a specific duration was selected from each year and sorted in increasing magnitudes. The frequency plotting position was computed from M/N+1, where M is the ranking of the yield and N is the total number of years (15). Thus, the smallest yield has a frequency of 1/16.
3. The irrigation demand-frequency-duration curves were constructed in the same manner, except that annual maximum values were selected.

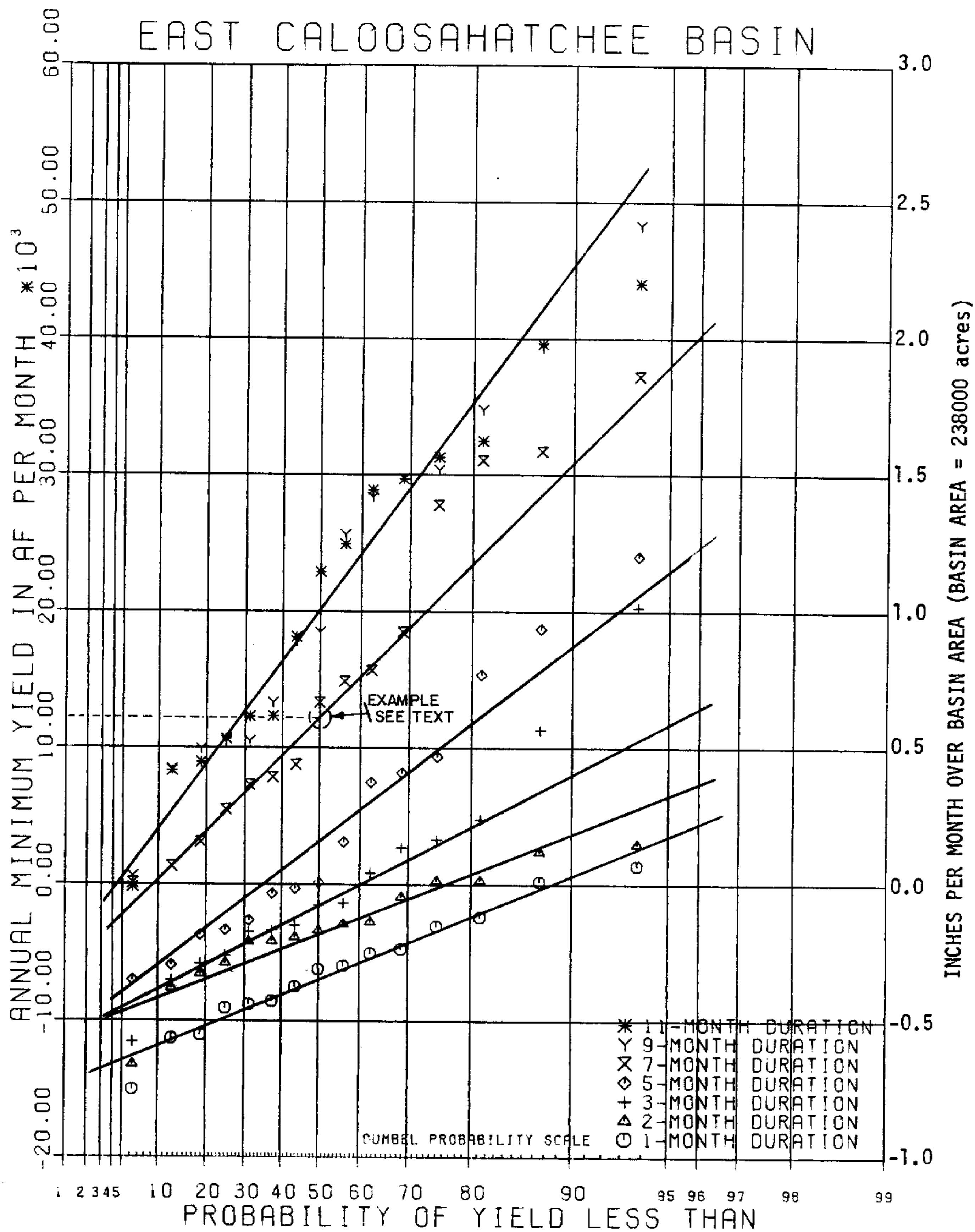


FIGURE 10
Yield-Frequency-Duration Curves, ECAL

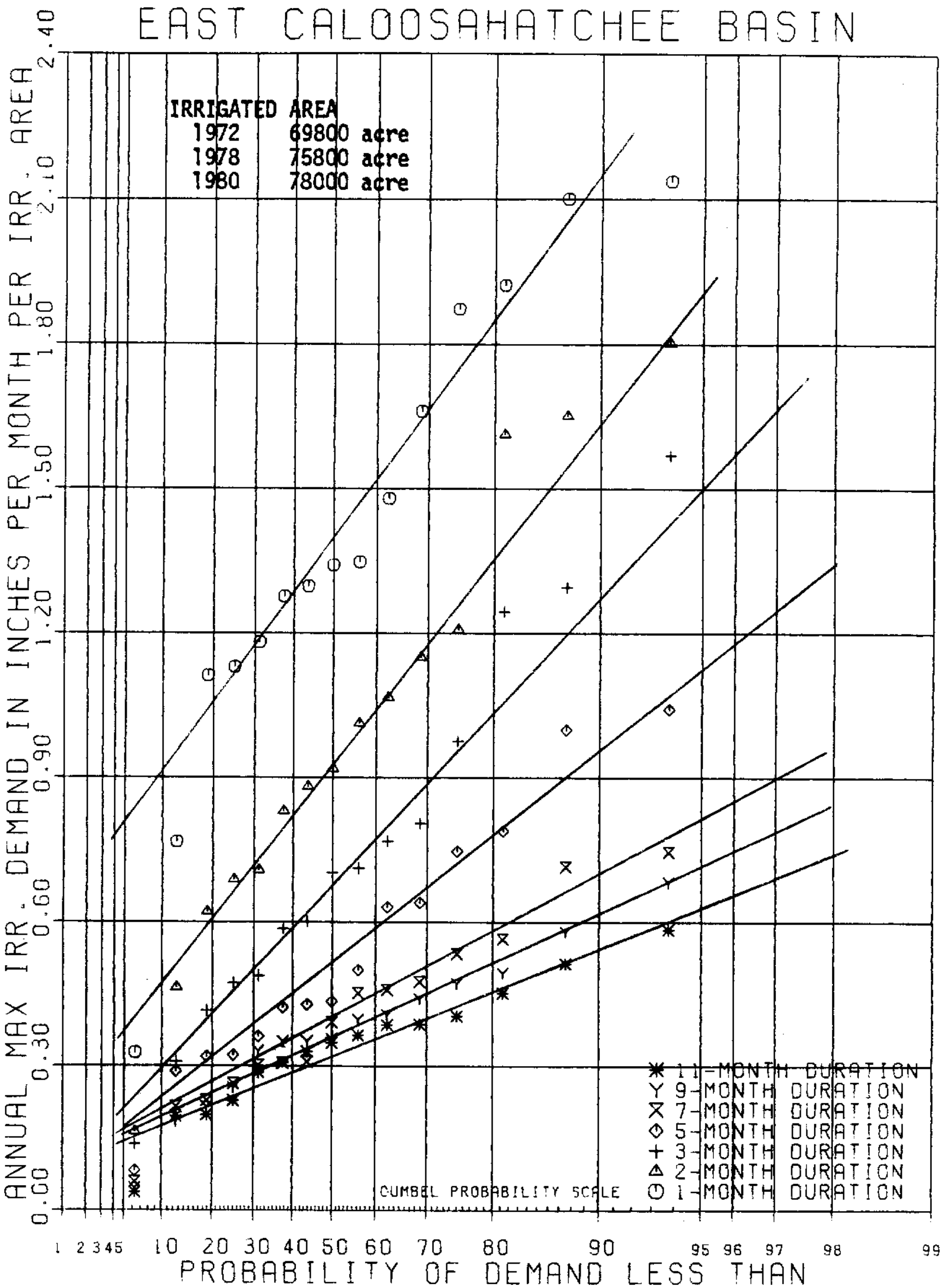


FIGURE 11
Demand-Frequency-Duration Curves, ECAL

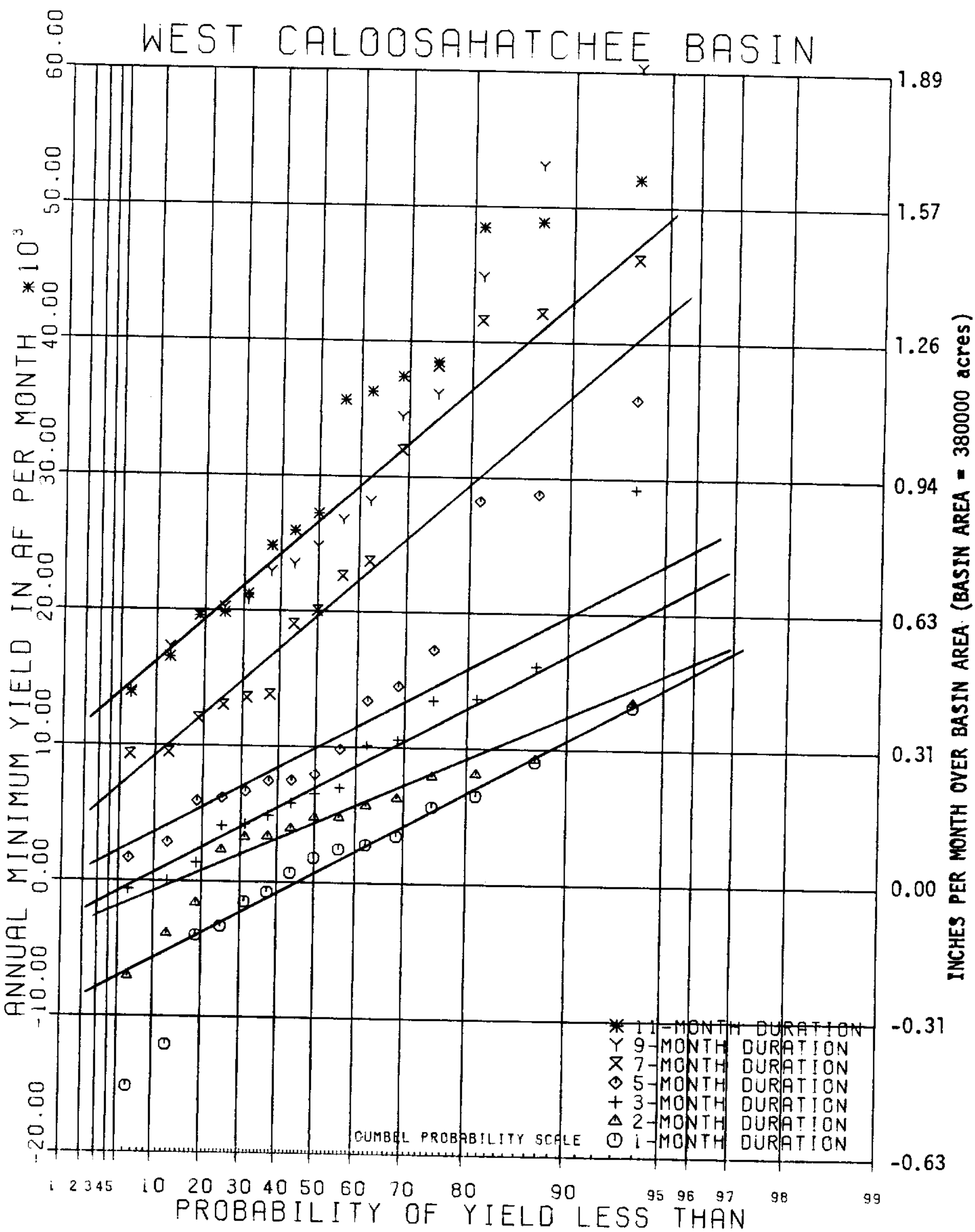


FIGURE 12
Yield-Frequency-Duration Curves, WCAL

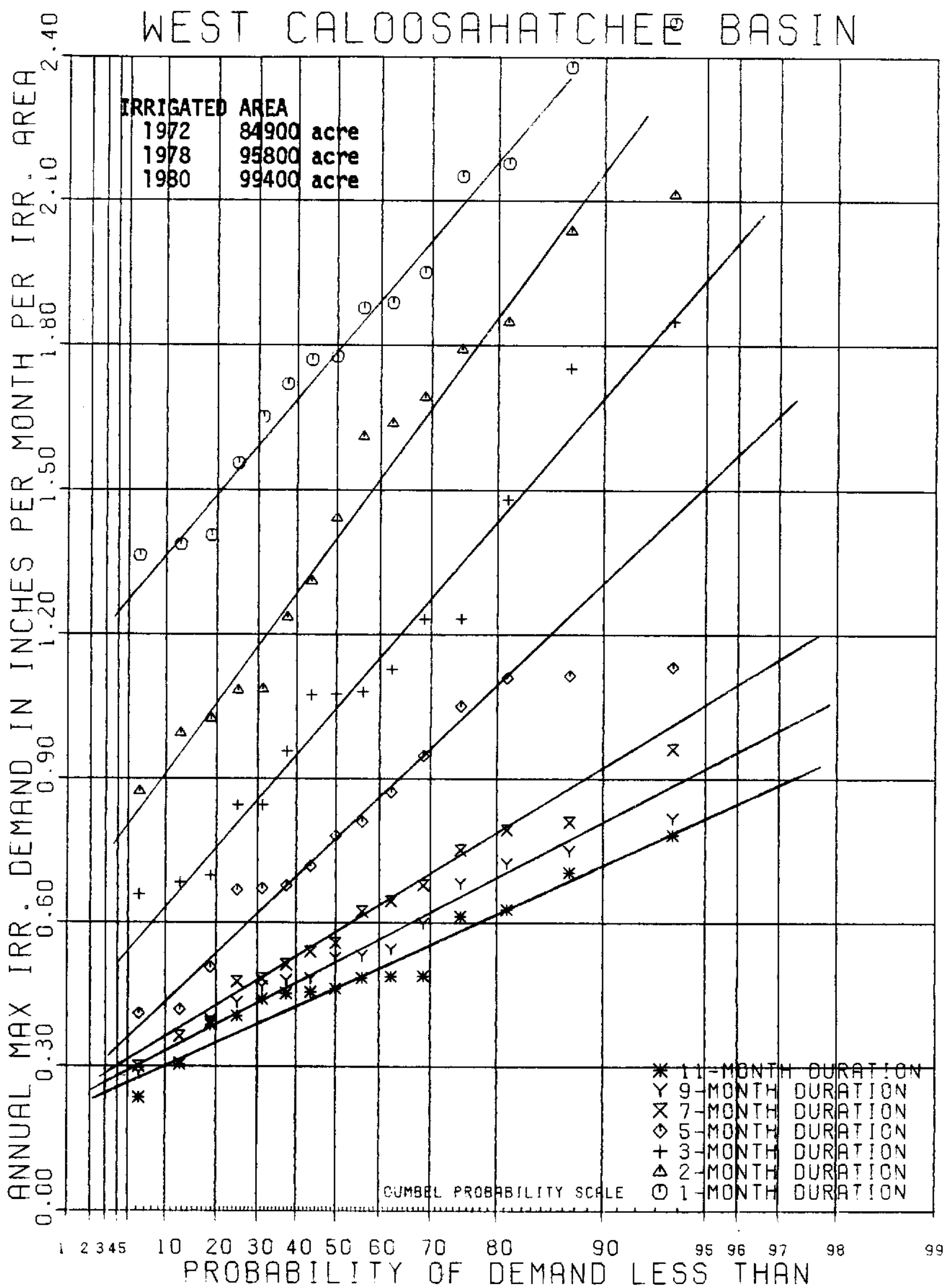


FIGURE 13
Demand-Frequency-Duration Curves, WCAL

The demand was expressed in inches per unit irrigated area. The irrigated acreages were assumed to vary linearly throughout the period of record.

B. Cumulative Yield and Demand Curves

1. The cumulative mass curves of the yields for different drought years can be obtained from the yield-frequency-duration curves. For example, to obtain the cumulative yield of the ECAL in a normal year (50% probability) for a 7-month duration, read the yield from the yield-frequency duration diagram (Figure 10) at the 50% probability level and from the 7-month duration curve. The yield (12,200 ac/ft per month), when multiplied by seven months, equals the cumulative yield (85,400 ac/ft, Figure 14). The cumulative mass yield for a normal year and for 10 and 20-year droughts were plotted in Figures 14 and 15.

2.. The cumulative mass curves of the irrigation can be obtained in a similar manner. In order to superimpose the total demand (irrigation and public) onto the cumulative mass yield curves, the following assumptions were made:

   a. The joint occurrence of the yield and demand was assumed to have the same probability level as that of either the yield or demand. Thus, a 20-year yield occurs at the same time as a 20-year demand. While not strictly accurate, this is a reasonable assumption as large rainfall deficit often results in low basin yield and high irrigation demand, or vice versa.

   b. As the irrigation demand is expressed in depth per irrigated area, it is necessary to multiply the irrigated area to the depth of demand to obtain the demand in ac/ft. The irrigated area

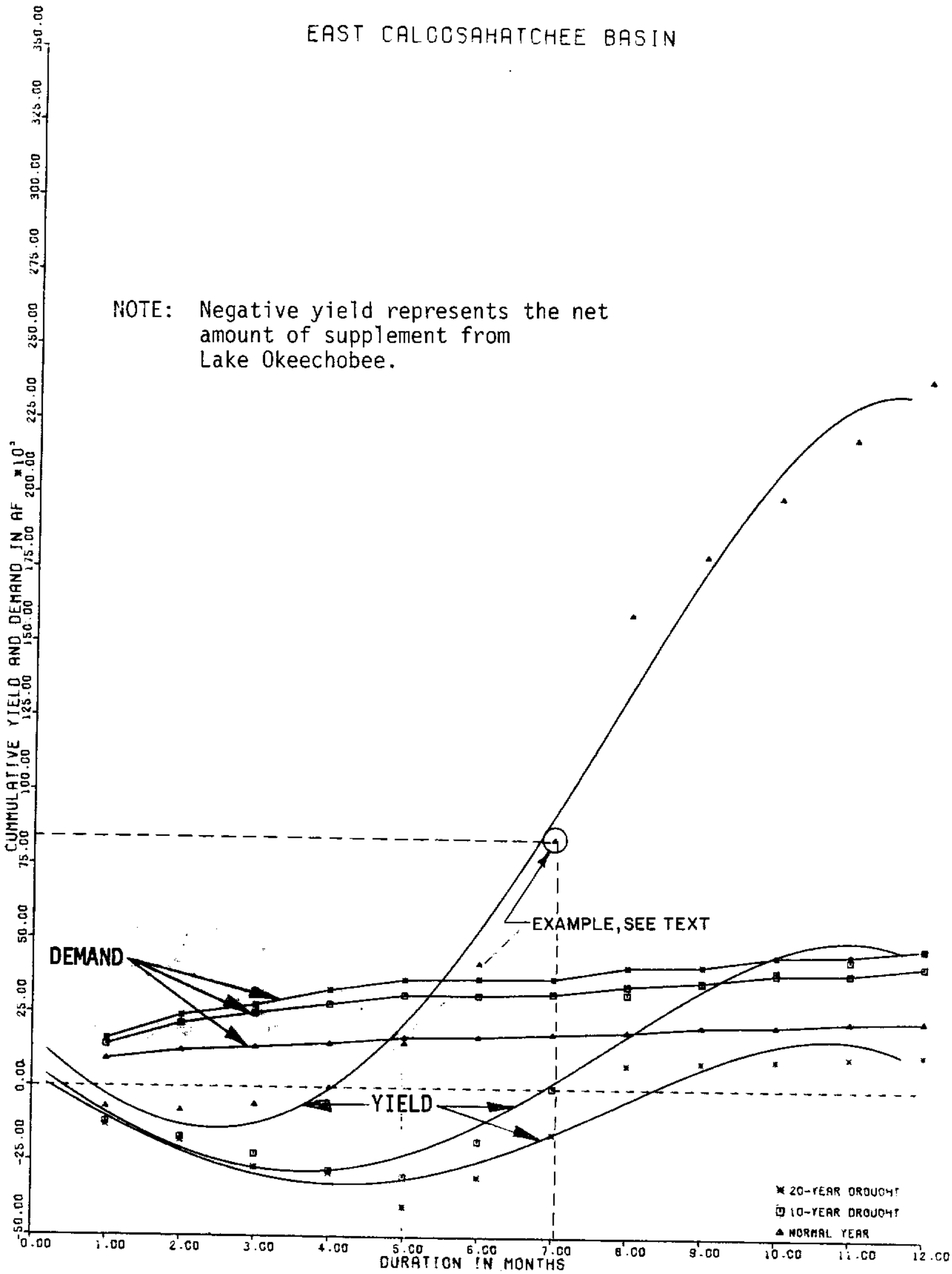


FIGURE 14
Cumulative Mass Curves of Yield and Demand, ECAL

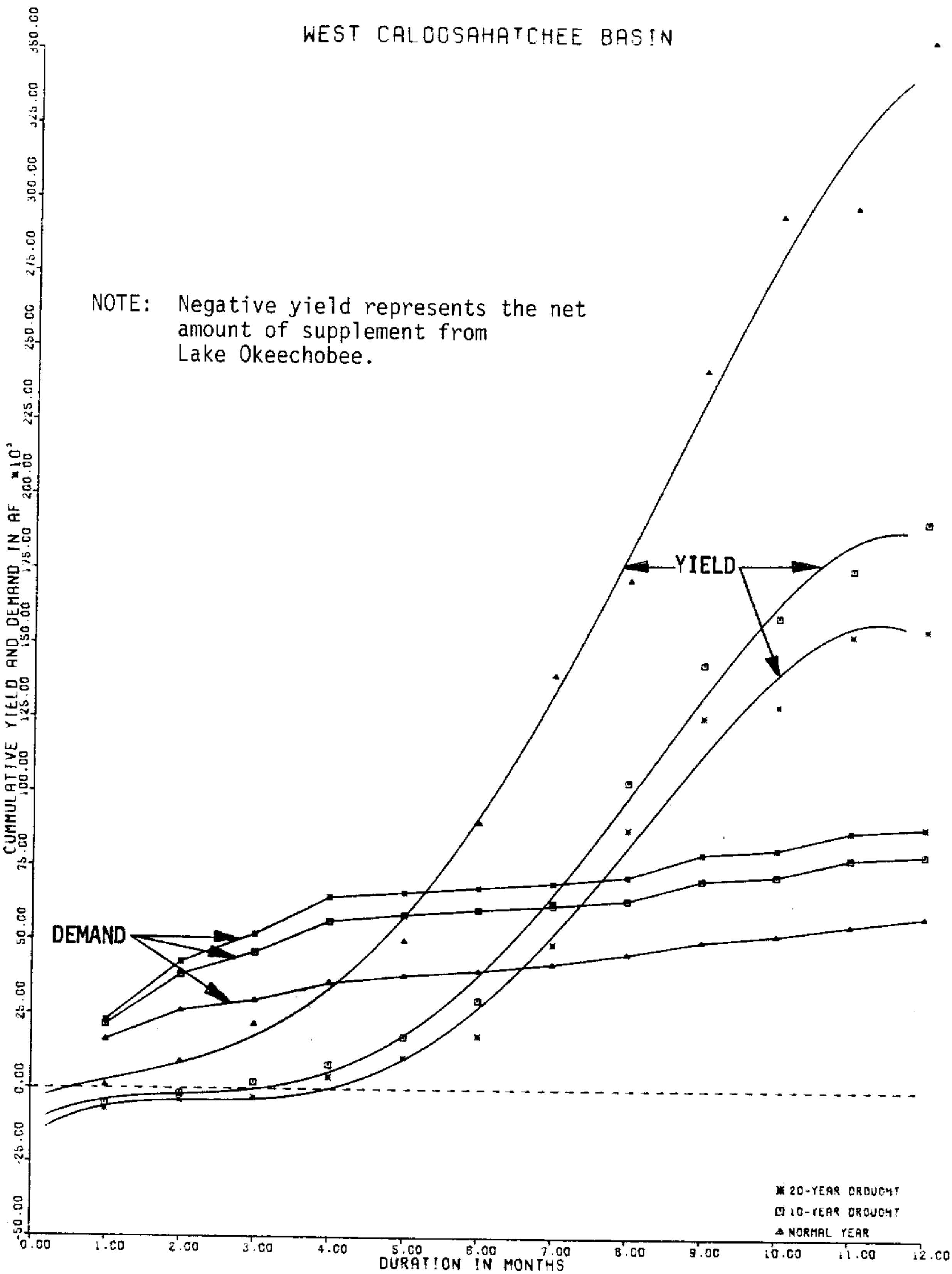


FIGURE 15
Cumulative Mass Curves of Yield and Demand, WCAL

changes from year to year. The 1980 irrigated acreage was used. To project irrigated acreage in future years, the historical irrigated acreages listed in Table 6 can be used for extrapolation.

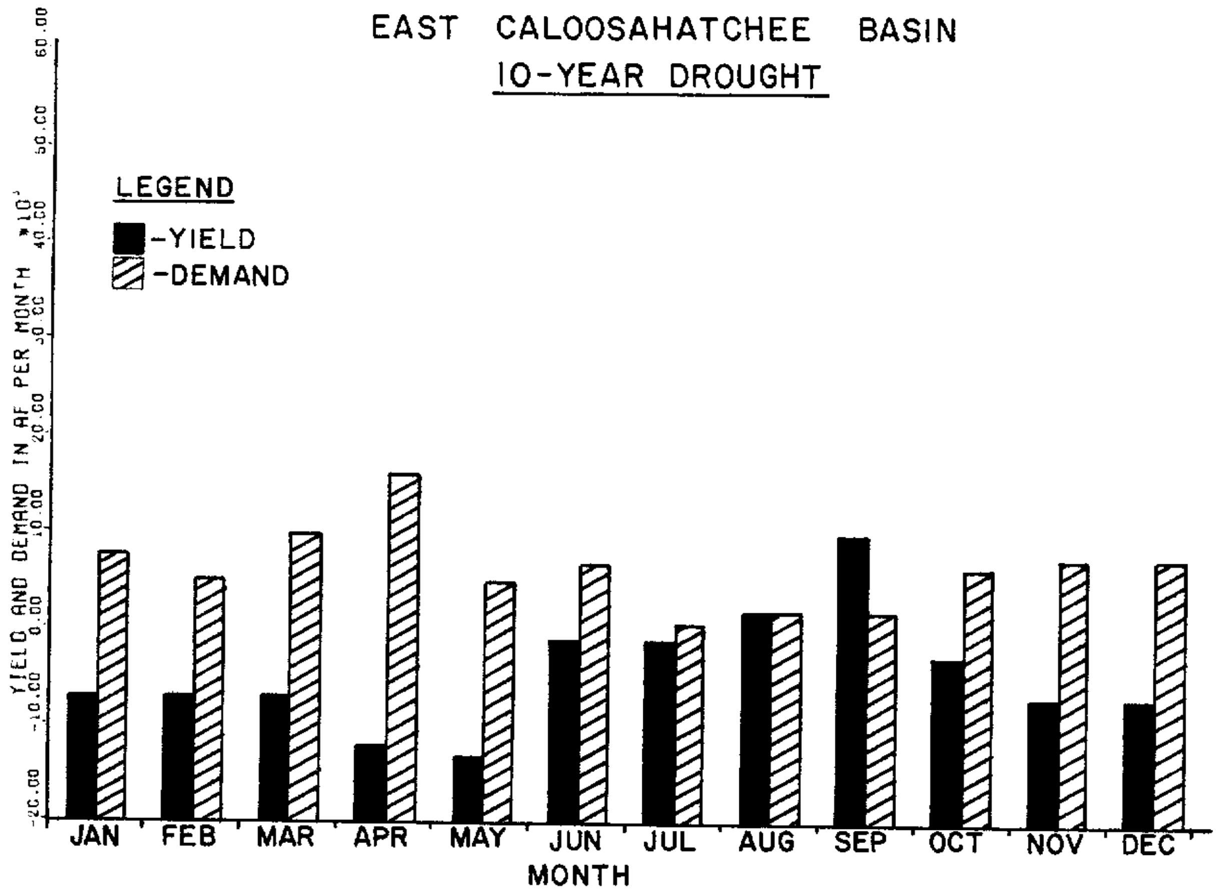
c. The public water demand must be added to the irrigation demand to obtain the total demand. The 1980 public water demand was used. To project public water demand in future years, the historical pumpage data in Table 4 can be used for extrapolation.

3. Positive deviation of the yield curve from the demand curve indicates a surplus condition, whereas a negative deviation indicates a deficient condition. The critical duration at which the cumulative yield just equals the cumulative demand is indicated by the intersection of the yield and demand curve. Accordingly, in a normal year the ECAL and WCAL are under deficient conditions for a duration of five months and four months respectively. In a 20-year drought, the WCAL is under deficient conditions for a duration of seven months, whereas the ECAL is under deficient conditions for practically the entire year. Thus, both basins are highly dependent on release from Lake Okeechobee to supplement the demand. The maximum amount of supplement to each basin can be obtained as the maximum negative yield from Figures 14 and 15.

C. Monthly Frequency Curves

1. The monthly yield-frequency and monthly demand-frequency curves were constructed by grouping the yield or demand values of each month and arranging the values of each month in increasing magnitudes. The plotting positions were calculated in the same manner as for the frequency-duration curves.

2. The sample of monthly yields or demands are not extremal data, but cover a full range of maximum and minimum values. Thus, the monthly yields and demands were plotted on Normal Probability Paper instead of on Gumbel Extremal Probability Paper (Figures 18 through 21). The data are very scattered and cover a much wider range than those for the frequency-duration curves. Variability is more apparent in the wet months than in the dry months. Variability is expected due to the fact that the data cover a full range of high values in flood years and low values in drought years.
3. Straight lines were fitted manually to the data. Since the present interest lies in the low yield region, for clarity purposes the data at high yield region are not shown. Because of the scattering of the data, the fitted lines can best be considered approximate. It is considered that it is unreliable to extrapolate values from the fitted lines beyond the 10-year drought period, although it is probably accurate enough for the more frequent occurrences.
4. The monthly yields and demands for a normal year and a 10-year drought were plotted in bar diagrams in Figures 16 and 17. Bar diagrams were used to emphasize the fact that the values shown do not indicate the true sequence of occurrence. Thus, a 10-year drought in January does not imply that a 10-year drought necessarily follows in February.
5. Figures 16 and 17 also indicate that April has the highest demand and May has the lowest yield. Conjunctively, April and May are the most critical months when the deficient conditions are most severe. May demarcates the end of the dry season and the beginning of the wet



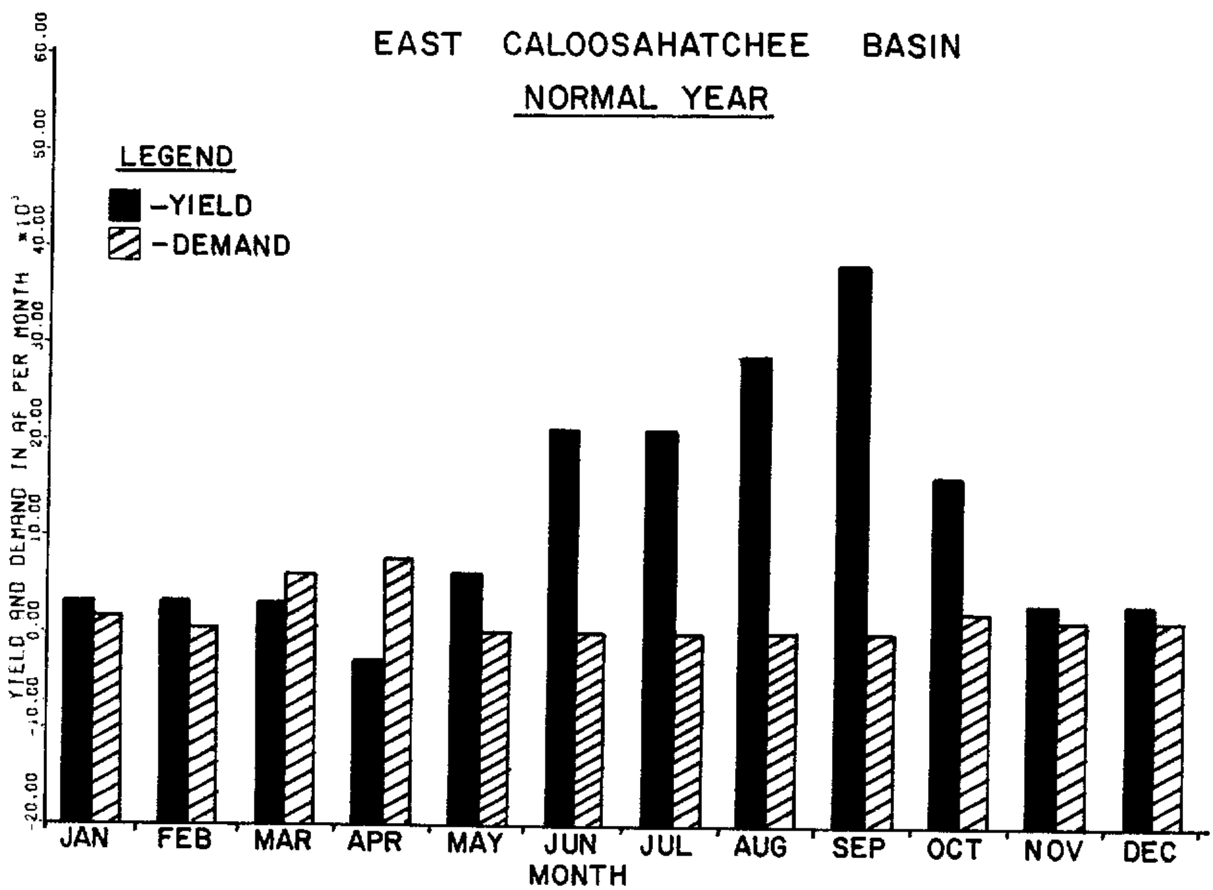
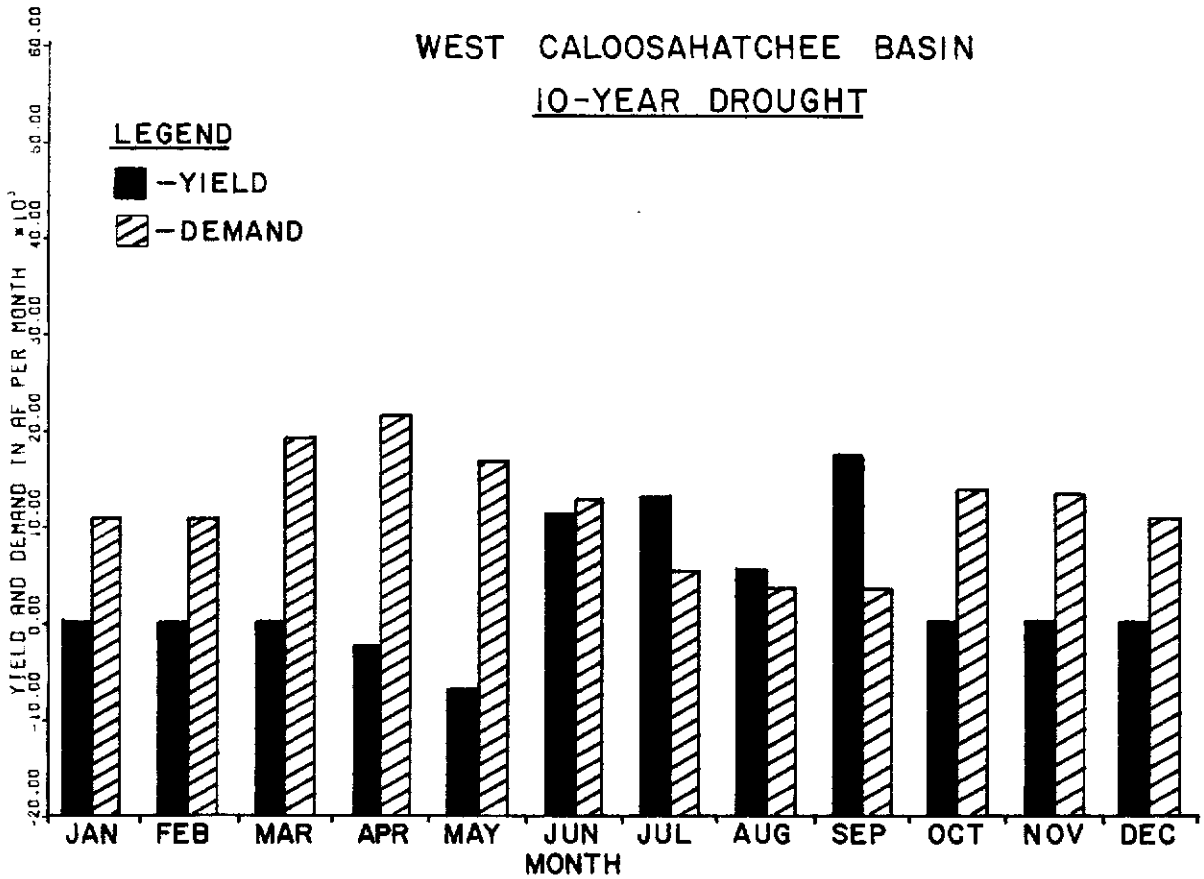


FIGURE 16

BAR DIAGRAM OF MONTHLY YIELD AND DEMAND, ECAL



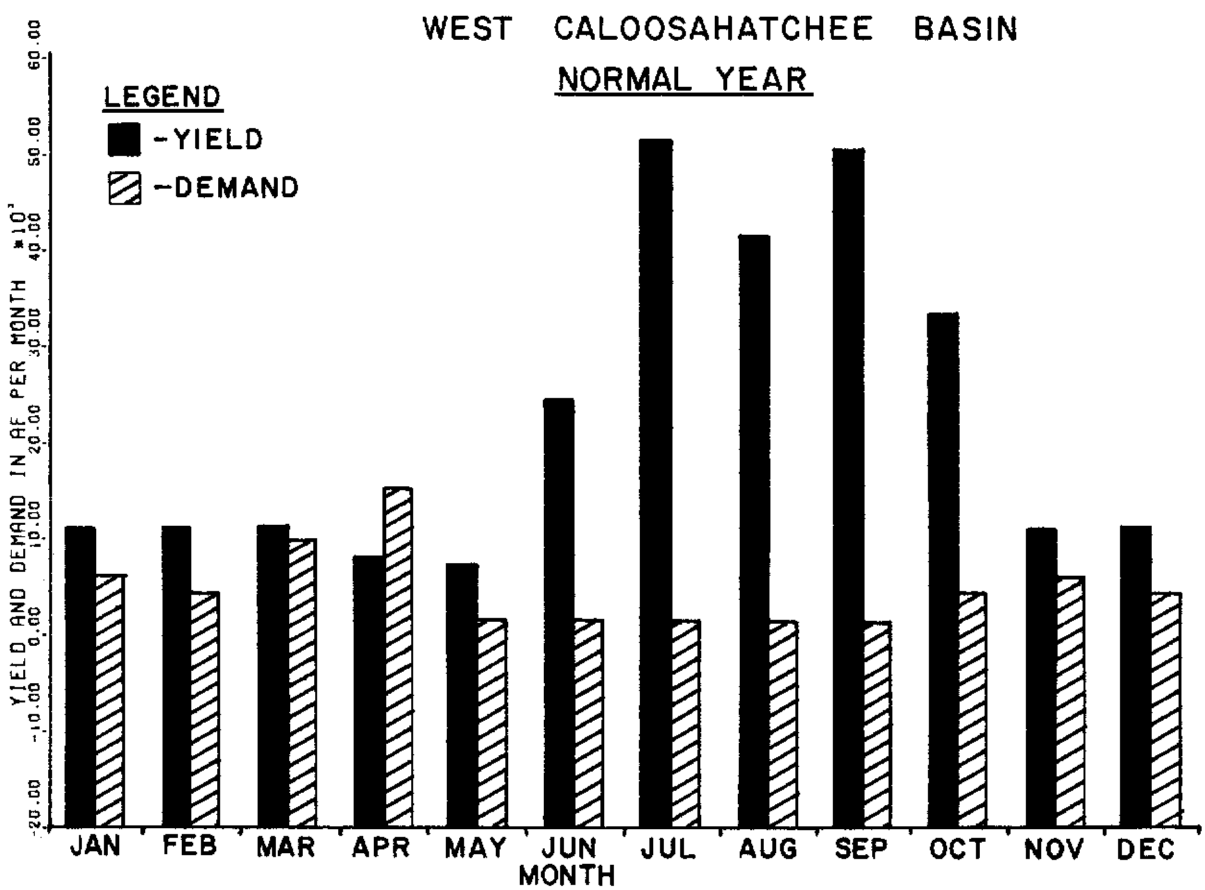


FIGURE 17

BAR DIAGRAM OF MONTHLY YIELD AND DEMAND, WCAL season. At the same time, the storage of the basin in May is at its lowest level. Should rains arrive late, the drought situation in May is likely to be most severe.

DISCUSSION AND RECOMMENDATION

The largest fresh water demand in the Caloosahatchee River Basin is for irrigation. In 1980 the public water demand amounted to about 27% of the total water used in the West Caloosahatchee Basin and less than 1% in the East Caloosahatchee Basin. However, the public water demand in the WCAL is the fastest increasing demand due to rapid population increase in western Lee County. If the present trend continues, the public water withdrawal from the WCAL will double in about eight years. The fresh water resources in western Lee County, however, are limited due to the constraints of the threat of coastal salt water intrusion to wellfields and the unsuitability of the river water in western Lee County for potable use. Thus, the increasing demand in western Lee County would inevitably impose its burden on the WCAL.

With the present structural configuration, the surface water resource of the Caloosahatchee Basin has been developed to its maximum capacity. In a 10-year drought, for instance, a deficient condition would occur in the Caloosahatchee Basin for a duration of about eight months, and releases from Lake Okeechobee to supplement the local demand would be necessary (Figures 14 and 15).

In order to avoid greater stress on Lake Okeechobee , the increasing water demand in the Caloosahatchee Basin must be met by the yield within the basin itself. Theoretically, the yield of the Caloosahatchee Basin can be expanded many times by storing the surplus runoff during the wet months for use in the dry months. In practice, the options to store the surplus runoff are hindered by many management, environmental, and structural limitations.

It is beyond the scope of this study to investigate the options and their limitations in detail. Generally, however, the option to store the surplus runoff in surface reservoirs is rather limited due to the lack of suitable sites and the large evaporation loss in the basin. The existing storage capacity of the aquifer is also limited due to the high water table conditions during the wet season when surplus water is available for storage. It appears that a more promising option would be to expand the usage of the shallow groundwater resource further inland, creating cones of depression, whereby surplus runoff can be stored effectively.

In future studies of this subject, it is recommended that:

1. More field data should be collected to verify the present basin yield estimates. Of primary concern is to improve the estimate of the irrigation water use. To accomplish this, the agricultural land use should be updated periodically, the amount of irrigated pasture should be delineated, and the irrigation practices, particularly that of pasture, should be investigated in greater detail.
2. More field data are needed to identify the shallow groundwater system in the basin. Data collection should be concentrated in the ECAL and the area north of the river where groundwater data are most scarce.
3. A detailed study should be conducted to investigate the conjunctive use of surface and groundwater resources in the basin. This includes:
    a. The identification of suitable sites for storage of surplus runoff.
    b. The identification of future wellfield sites.

c. The study of the feasibility of diverting surface water or treated wastewater to recharge the existing or future wellfield sites.

d. The assessment of the environmental impact that may respond to any proposed change.

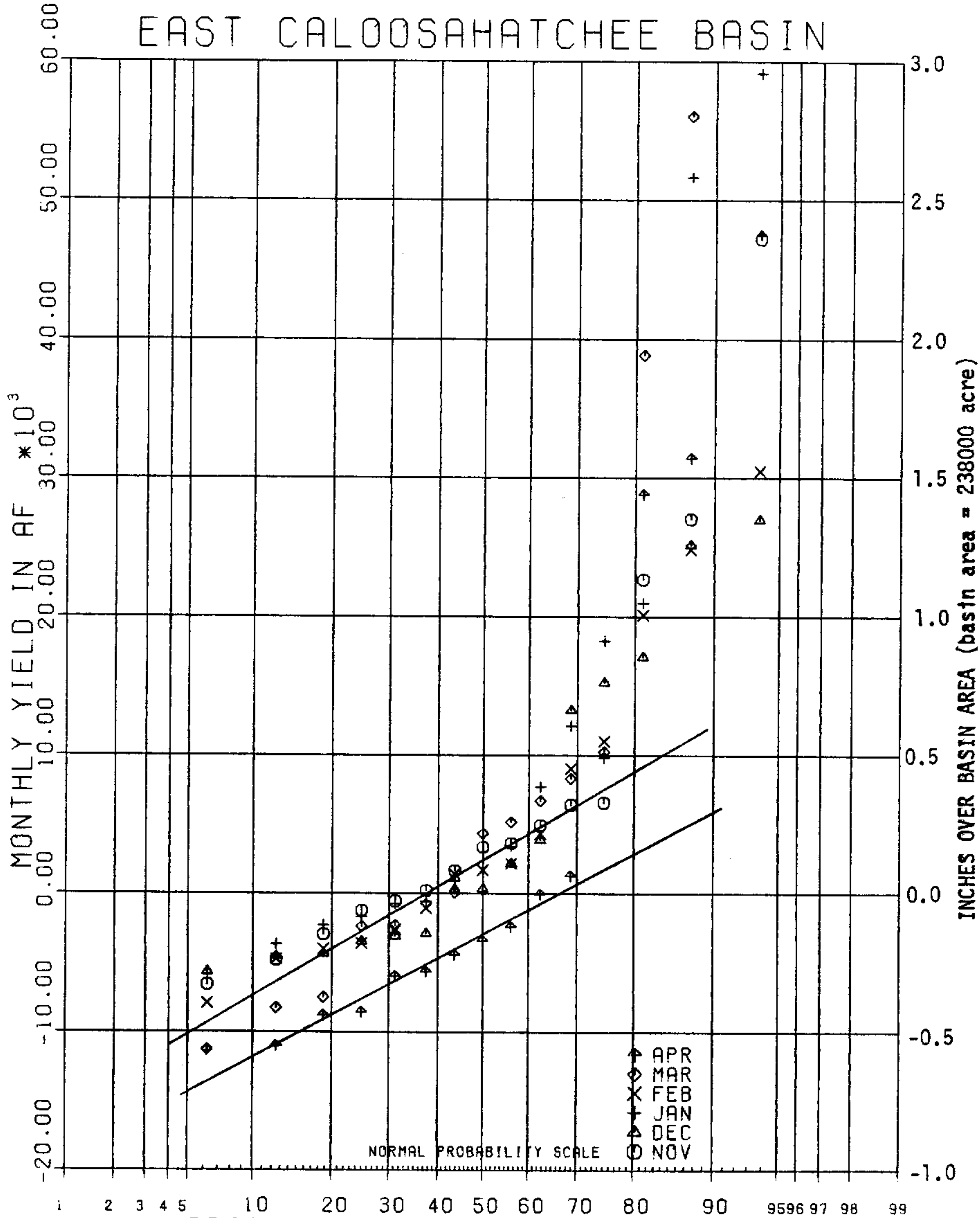


FIGURE 18a
Monthly Yield-Frequency Curves, ECAL (Nov-Apr)

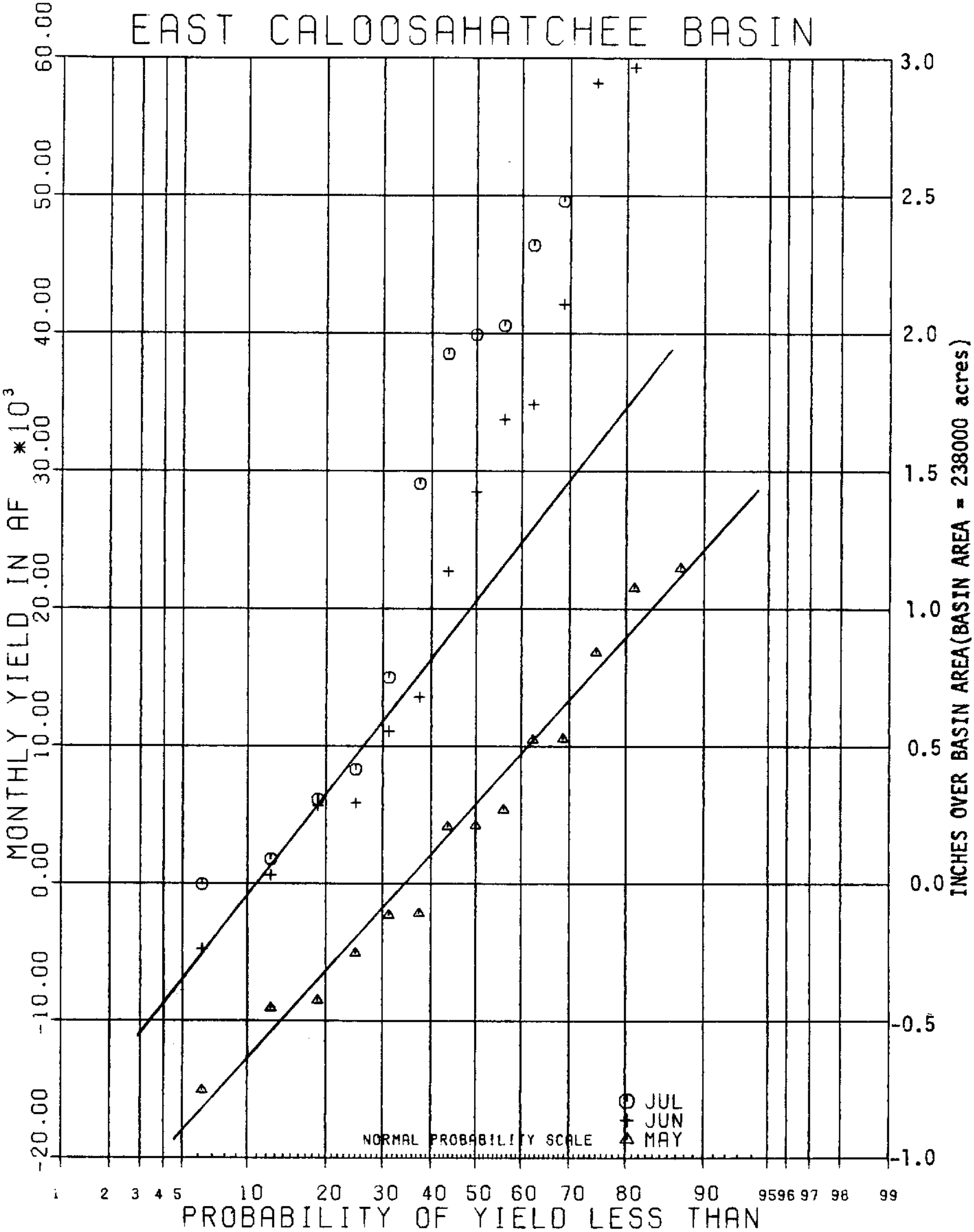


FIGURE 18b
Monthly Yield Frequency Curves, ECAL (May-Jul)

EAST CALOOSAHATCHEE BASIN

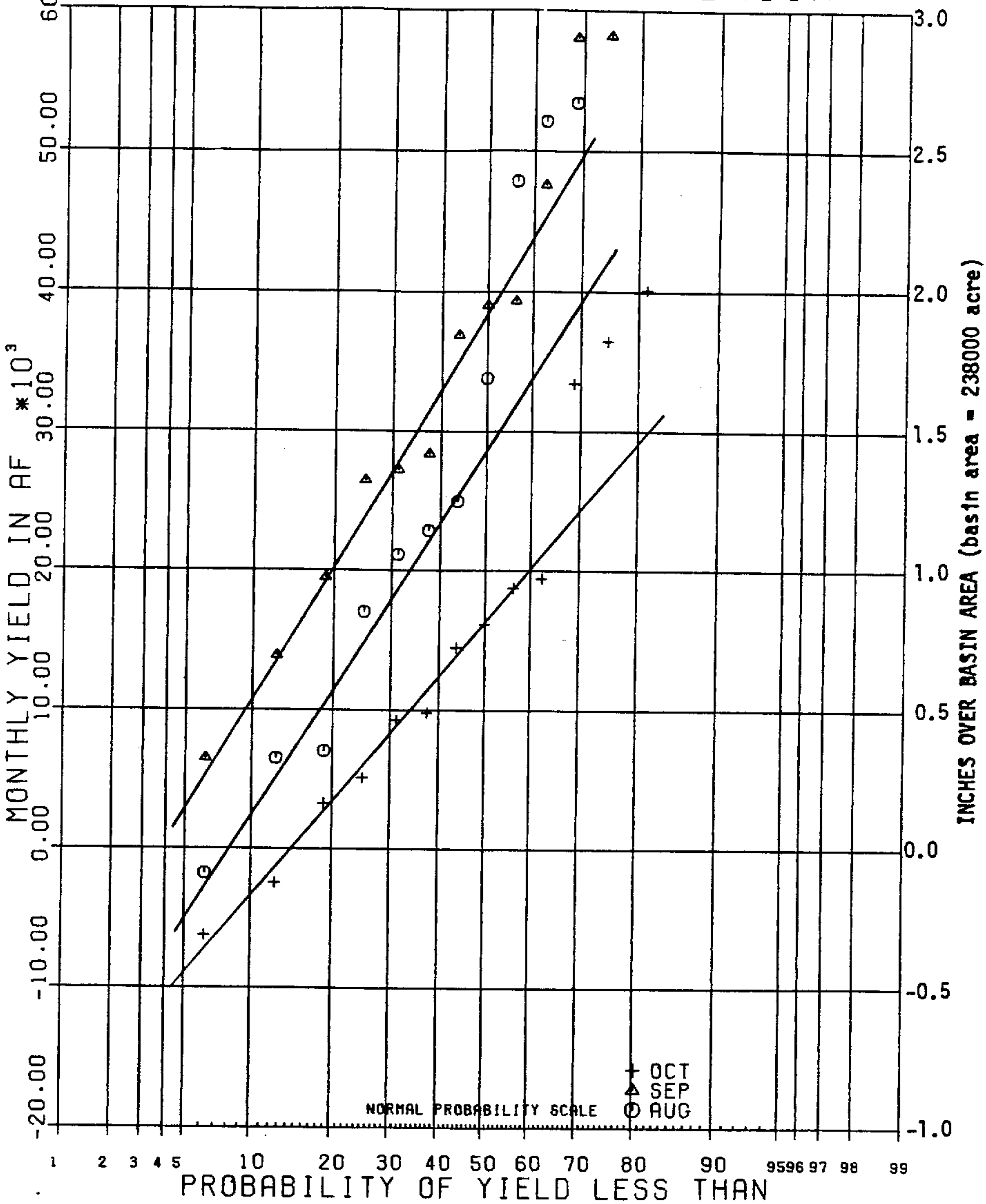


FIGURE 18c
Monthly Yield Frequency Curves, ECAL (Aug-Oct)

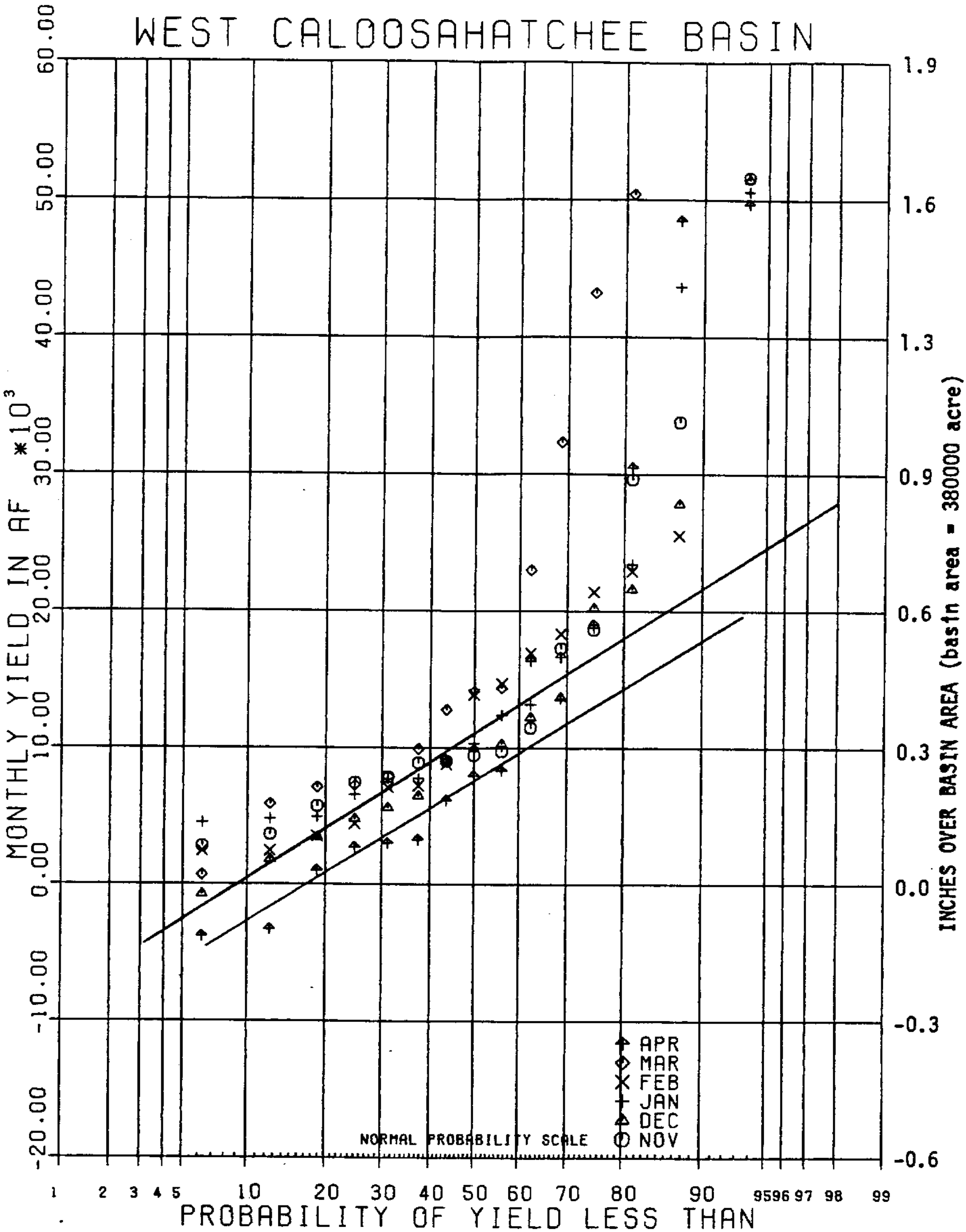


FIGURE 19a
Monthly Yield Frequency Curves, WCAL (Nov-Apr)

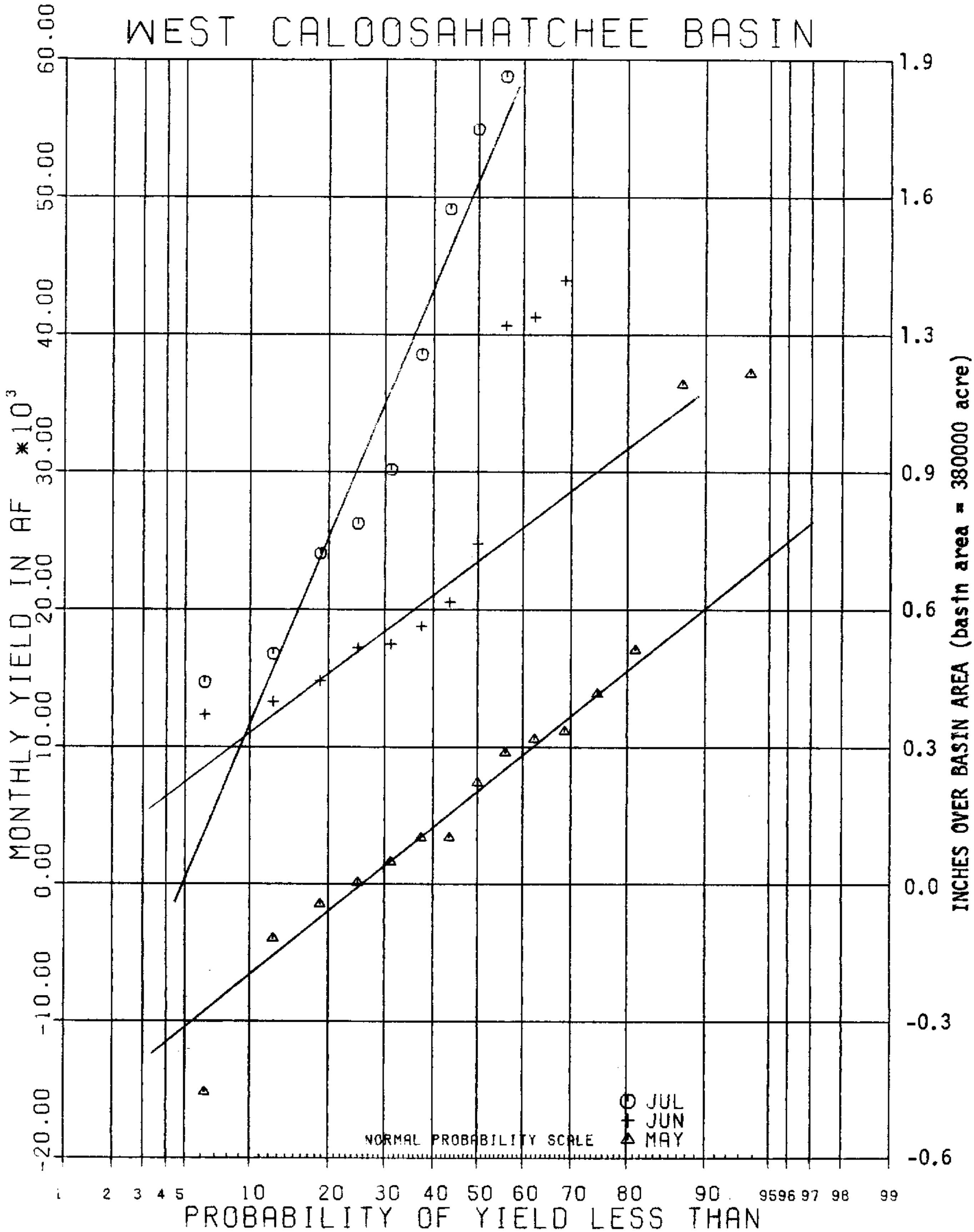


FIGURE 19b
Monthly Yield Frequency Curves, WCAL (May-Jul)

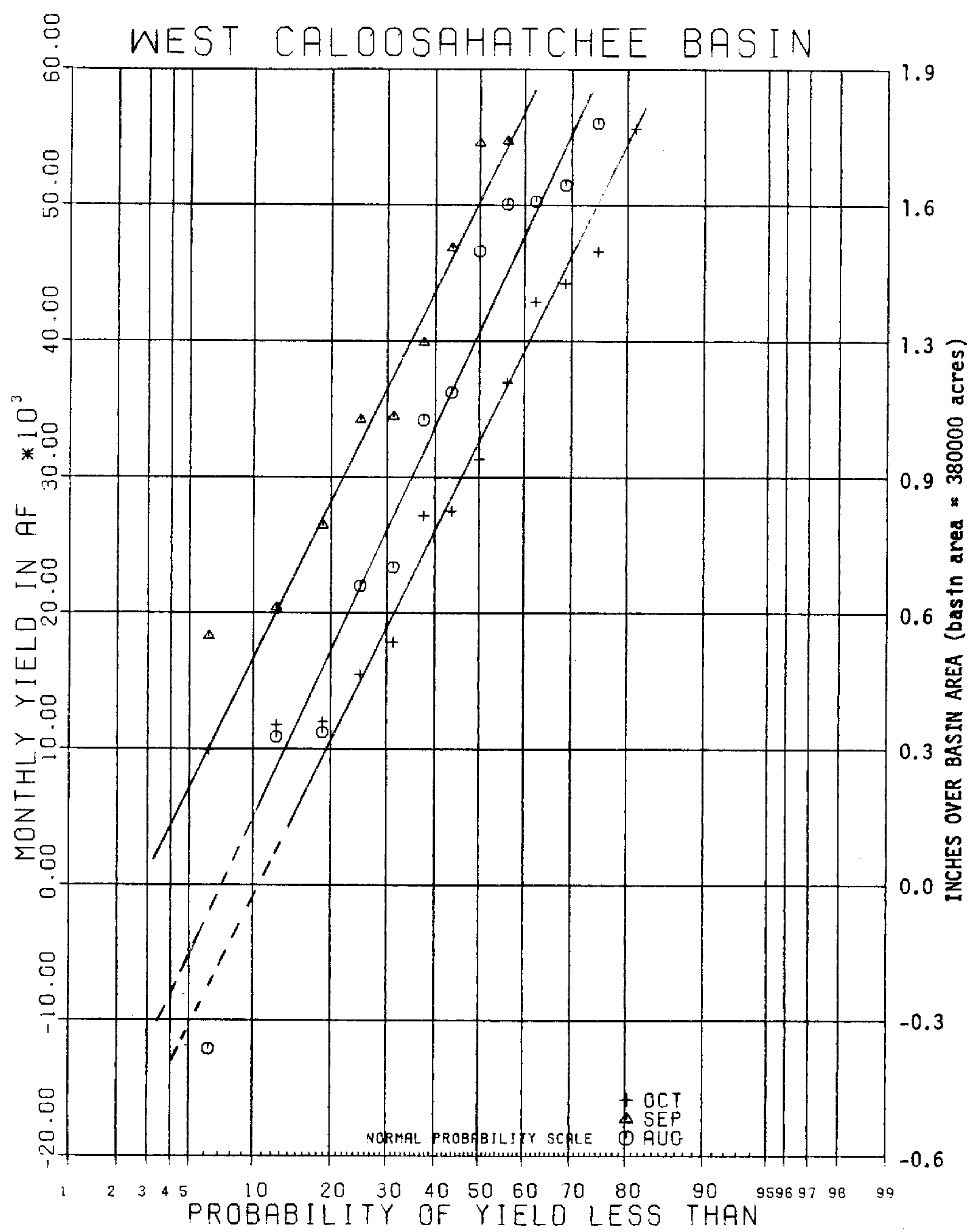


FIGURE 19c
Monthly Yield Frequency Curves, WCAL (Aug-Oct)

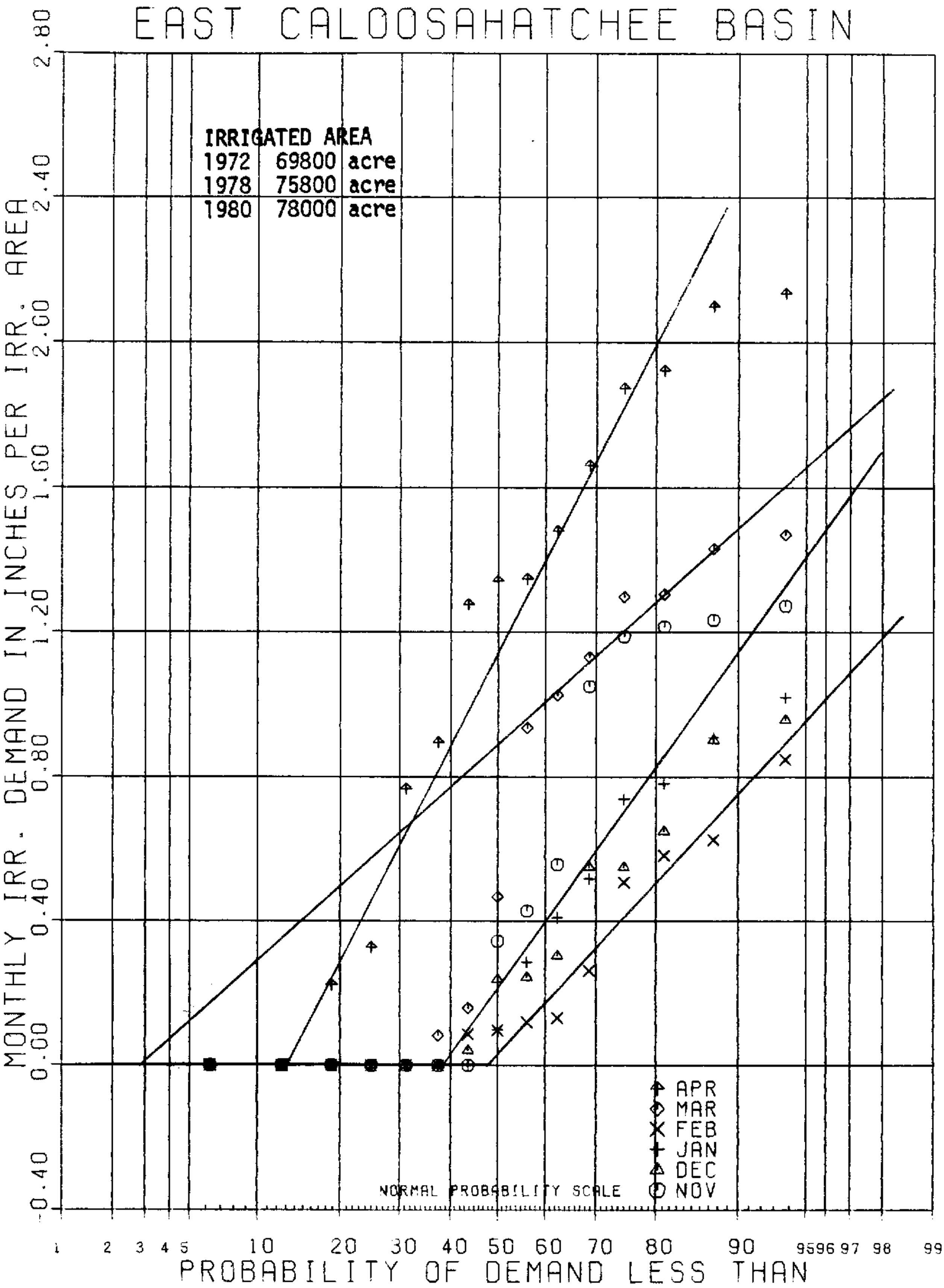


FIGURE 20a
Monthly Irrigation Demand Frequency Curves, ECAL (Nov-Apr)

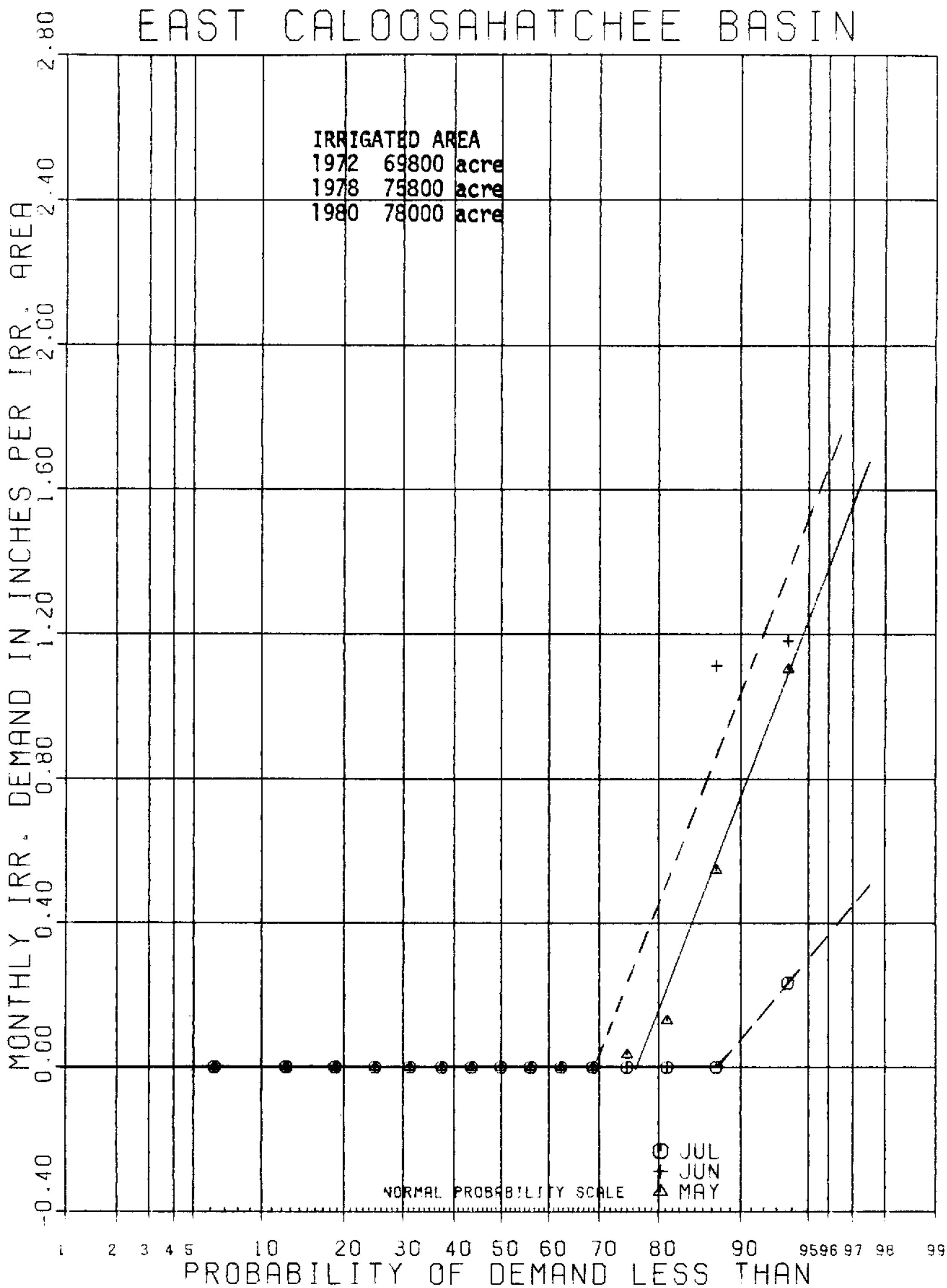


FIGURE 20b
Monthly Irrigation Demand Frequency Curves, ECAL (May-Jul)

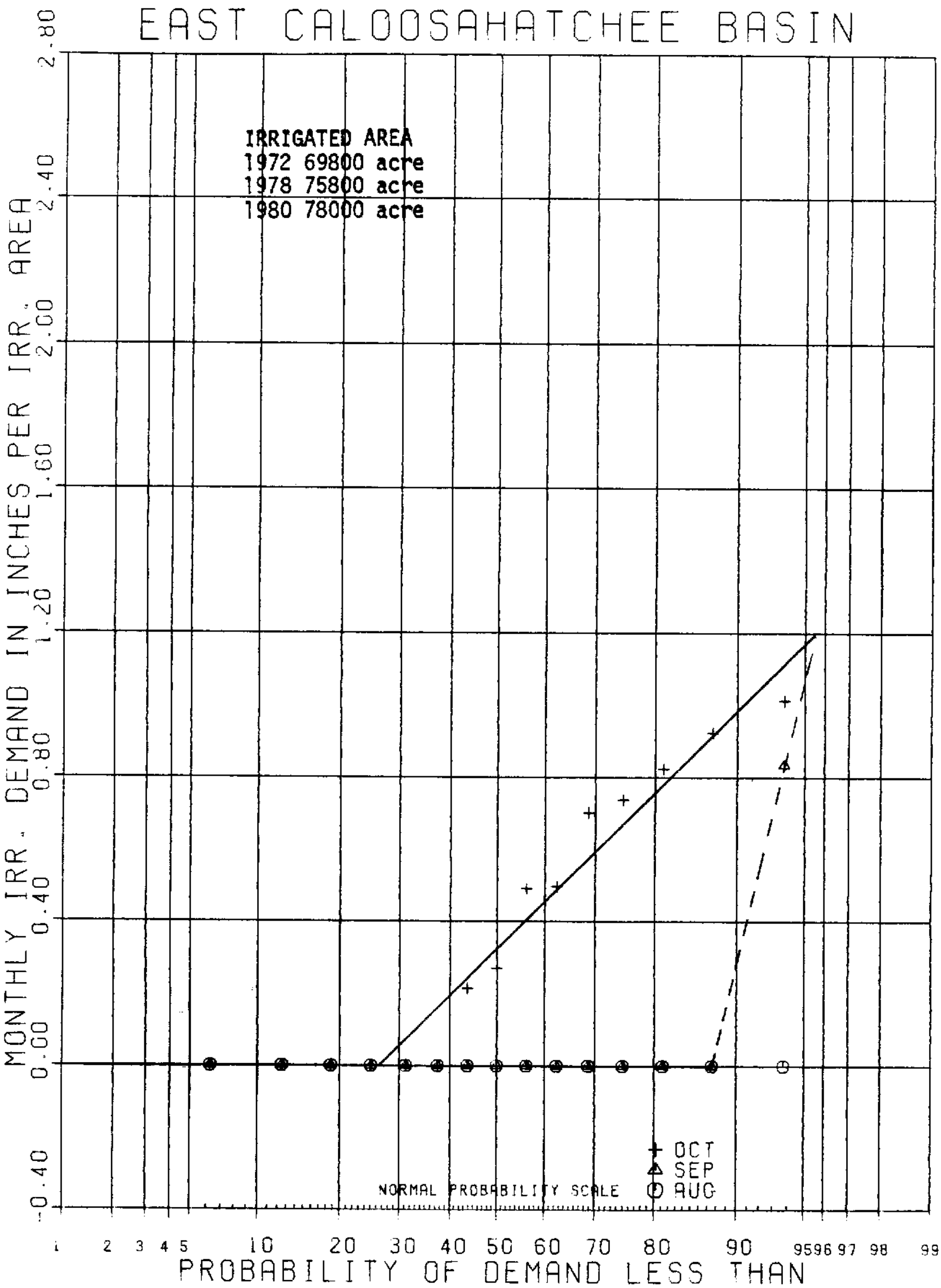


FIGURE 20c
Monthly Irrigation Demand Frequency Curves, ECAL (Aug-Oct)

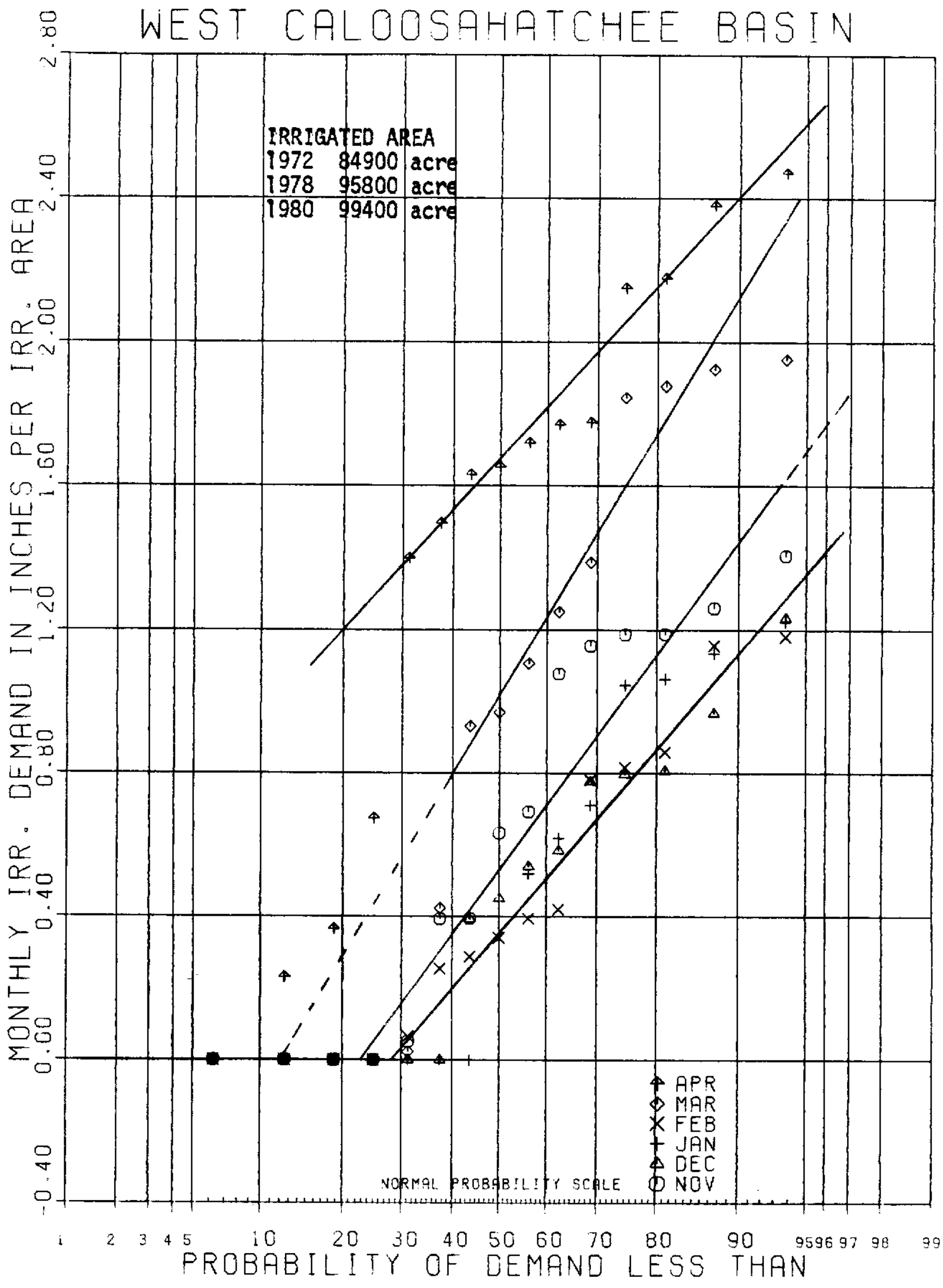


FIGURE 21a
Monthly Irrigation Demand Frequency Curves, WCAL (Nov-Apr)

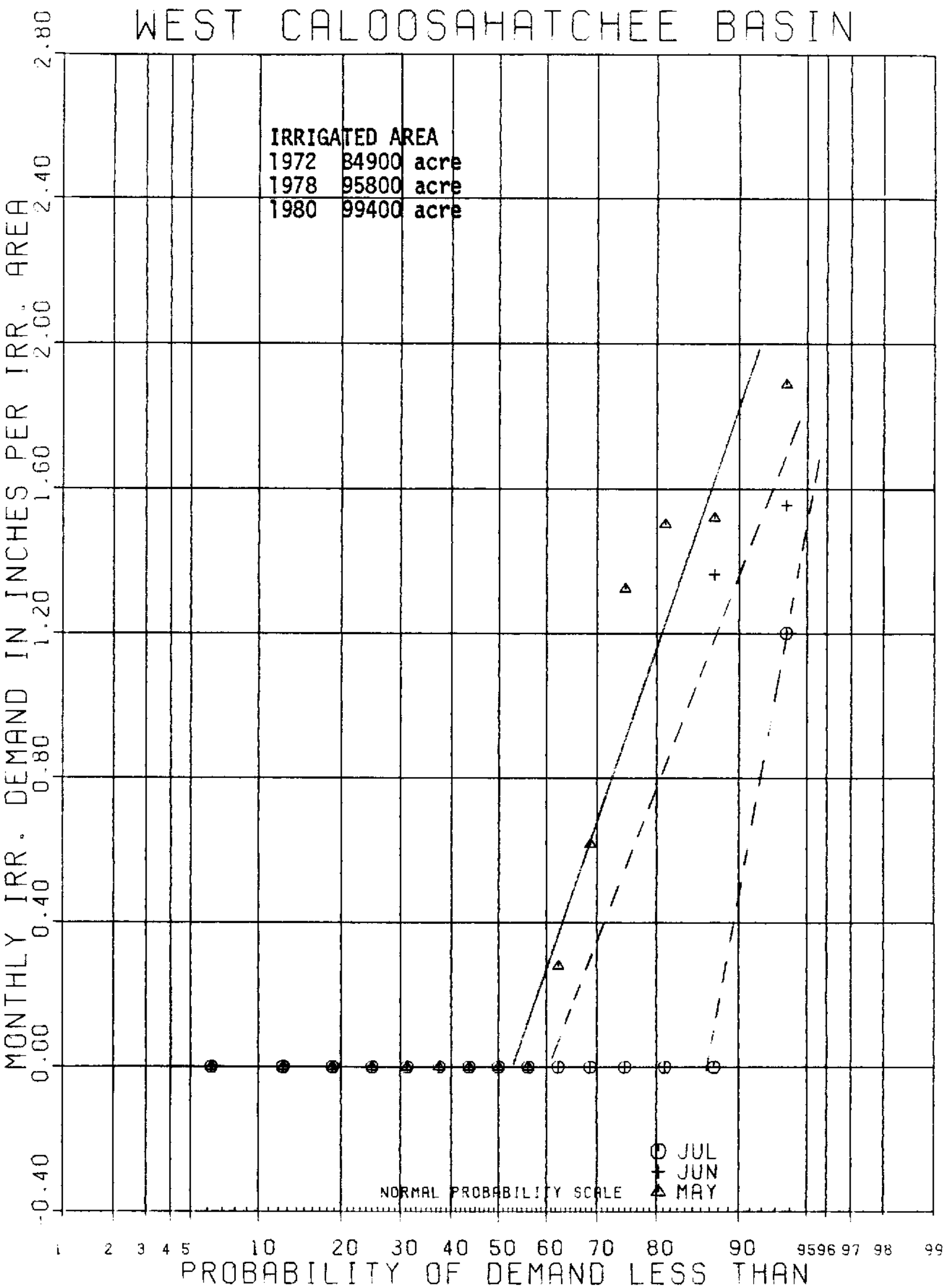


FIGURE 21b
Monthly Irrigation Demand Frequency Curves, WCAL (May-Jul)

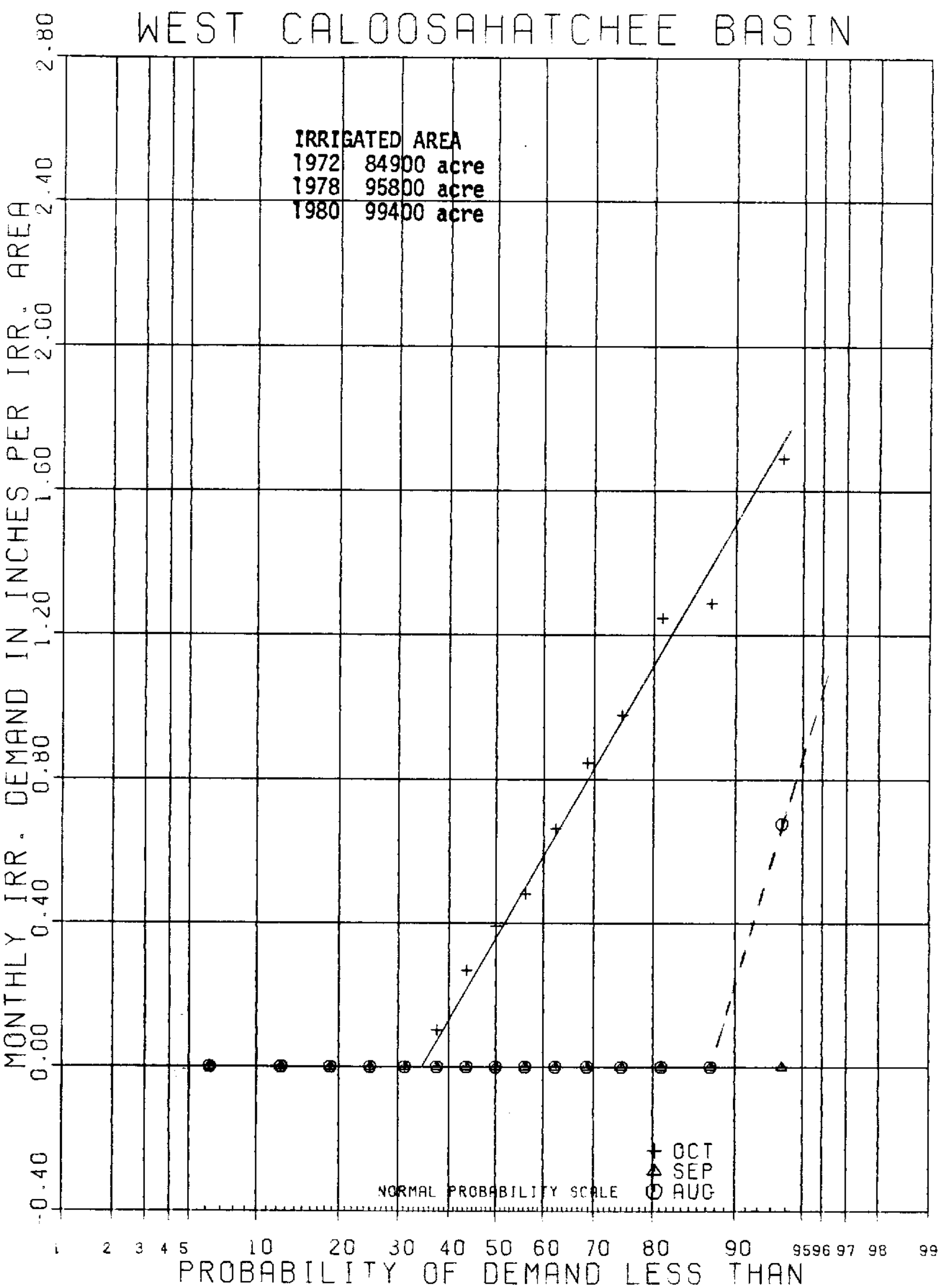


FIGURE 21c
Monthly Irrigation Demand Frequency Curves, WCAL (Aug-Oct)

YEAR OF 66 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-66	4.04	2.50	10.	213.	202.	227.	140.	615.	13111.	12409.	1.02	1.02	0.00	6.	6.	12116.
2-15-66	2.79	3.12	10.	213.	204.	157.	175.	555.	11842.	11305.	1.22	1.22	0.00	6.	6.	11011.
3-15-66	.53	5.00	1863.	2367.	508.	30.	281.	114551.	145564.	31263.	1.63	.33	1.30	6.	7896.	38859.
4-15-66	2.96	6.54	3537.	4313.	780.	166.	367.	210466.	256666.	46401.	2.04	1.81	.22	6.	1370.	47471.
5-15-66	4.27	6.71	1828.	2002.	176.	240.	377.	112399.	123109.	10847.	2.45	2.45	0.00	6.	6.	10553.
6-15-66	11.84	6.51	2758.	3765.	1002.	664.	365.	164112.	224026.	59615.	2.04	2.04	0.00	6.	6.	59321.
7-15-66	9.01	5.10	2882.	4212.	1326.	506.	286.	177207.	258983.	81557.	2.24	2.24	0.00	6.	6.	81263.
8-15-66	9.88	5.87	3151.	4702.	1547.	554.	330.	193747.	289088.	95116.	2.24	2.24	0.00	6.	6.	94822.
9-15-66	6.82	4.86	578.	2384.	1805.	383.	273.	34393.	141879.	107376.	1.83	1.83	0.00	6.	6.	107082.
10-15-66	2.20	4.66	1833.	2353.	522.	123.	261.	112707.	144655.	32086.	1.63	1.36	.27	6.	1646.	33432.
11-15-66	.15	3.82	900.	783.	-113.	8.	214.	53554.	46617.	-6731.	1.22	.04	1.19	6.	7231.	200.
12-15-66	.60	2.88	130.	74.	-54.	34.	162.	7993.	4549.	-3316.	1.02	.37	.65	6.	3953.	337.
TOTAL	55.09	57.56	19480.	27382.	7904.	3092.	3230.	1182301.	1660091.	477928.	20.59	16.96	3.63	73.	22139.	496466.

YEAR OF 67 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-67	1.17	3.21	39.	28.	-9.	66.	180.	2367.	1714.	-539.	1.02	.73	.29	6.	1753.	914.
2-15-67	3.13	3.22	20.	56.	36.	176.	181.	1133.	3105.	1977.	1.22	1.22	0.00	6.	6.	1683.
3-15-67	.30	5.37	139.	65.	-70.	17.	301.	8547.	3973.	-4289.	1.63	.16	1.47	6.	8944.	4355.
4-15-67	.02	6.98	487.	209.	-271.	1.	391.	28979.	12459.	-16129.	2.04	-.10	2.14	6.	13002.	-3428.
5-15-67	2.06	7.82	307.	115.	-187.	116.	439.	18877.	7059.	-11495.	2.45	1.34	1.10	6.	6720.	-5075.
6-15-67	14.09	5.90	5.	585.	573.	791.	331.	298.	34831.	34074.	2.04	2.04	0.00	6.	6.	33780.
7-15-67	6.47	6.49	5.	998.	993.	363.	364.	307.	61334.	61028.	2.24	2.24	0.00	6.	6.	60734.
8-15-67	4.81	5.67	5.	787.	783.	270.	318.	307.	48408.	48149.	2.24	2.24	0.00	6.	6.	47855.
9-15-67	8.29	5.34	5.	340.	333.	465.	300.	298.	20261.	19798.	1.83	1.83	0.00	6.	6.	19504.
10-15-67	2.30	5.16	5.	639.	637.	129.	290.	307.	39291.	39144.	1.63	1.42	.21	6.	1308.	40152.
11-15-67	.12	3.66	143.	77.	-63.	7.	206.	8509.	4577.	-3733.	1.22	.01	1.21	6.	7394.	3361.
12-15-67	2.18	3.05	62.	10.	-52.	122.	171.	3831.	615.	-3167.	1.02	1.02	0.00	6.	6.	-3461.
TOTAL	44.94	61.87	1222.	3909.	2702.	2522.	3472.	73759.	237626.	164817.	20.59	14.16	6.42	75.	39158.	200375.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: COMSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 68 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-68	.47	2.66	105.	22.	-81.	26.	149.	6456.	1379.	-4955.	1.02	.28	.74	6.	4500.	-755.
2-15-68	2.13	3.22	124.	42.	-80.	120.	181.	6887.	2355.	-4470.	1.22	1.22	0.00	6.	6.	-4765.
3-15-68	1.07	5.00	126.	35.	-87.	60.	281.	7747.	2180.	-5347.	1.63	.69	.94	6.	5700.	53.
4-15-68	.84	5.66	377.	152.	-221.	47.	318.	22433.	9020.	-13143.	2.04	.56	1.48	6.	9007.	-4436.
5-15-68	11.16	5.34	74.	254.	175.	626.	300.	4519.	15621.	10775.	2.45	2.45	0.00	6.	6.	10482.
6-15-68	10.87	5.30	1795.	3634.	1834.	610.	297.	106810.	216238.	109115.	2.04	2.04	0.00	6.	6.	108822.
7-15-68	8.82	5.79	3547.	5309.	1759.	495.	325.	218097.	326445.	108179.	2.24	2.24	0.00	6.	6.	107885.
8-15-68	4.31	5.66	3860.	4236.	377.	242.	317.	237342.	260438.	23171.	2.24	2.24	0.00	6.	6.	22877.
9-15-68	5.39	5.31	20.	482.	463.	302.	298.	1172.	28702.	27525.	1.83	1.83	0.00	6.	6.	27231.
10-15-68	4.33	4.63	17.	614.	598.	243.	260.	1015.	37743.	36745.	1.63	1.63	0.00	6.	6.	36452.
11-15-68	2.62	3.26	5.	391.	386.	147.	183.	298.	23250.	22988.	1.22	1.22	0.00	6.	6.	22695.
12-15-68	.18	2.62	125.	248.	125.	10.	147.	7686.	15245.	7696.	1.02	.06	.96	6.	5839.	13235.
TOTAL	52.19	54.45	10174.	15419.	5248.	2929.	3056.	620461.	938614.	318279.	20.59	16.47	4.11	77.	25096.	339776.

YEAR OF 69 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-69	1.49	2.81	5.	54.	50.	84.	158.	307.	3330.	3097.	1.02	.92	.10	7.	607.	3404.
2-15-69	1.79	3.40	22.	37.	17.	100.	191.	1216.	2065.	940.	1.22	1.10	.12	6.	735.	1375.
3-15-69	4.98	3.91	2642.	3560.	917.	279.	220.	162450.	218898.	56388.	1.63	1.63	0.00	7.	7.	56095.
4-15-69	1.05	5.24	1995.	2024.	33.	59.	294.	118711.	120441.	1966.	2.04	.70	1.34	6.	8161.	9827.
5-15-69	3.99	6.20	1814.	2187.	375.	224.	348.	111539.	134444.	23029.	2.45	2.41	.04	7.	221.	22951.
6-15-69	9.45	5.50	1891.	3385.	1490.	530.	309.	112522.	201419.	88675.	2.04	2.04	0.00	6.	6.	88381.
7-15-69	4.60	5.43	720.	1373.	654.	258.	305.	44271.	84434.	40210.	2.24	2.24	0.00	7.	7.	39916.
8-15-69	6.77	5.46	2361.	3215.	853.	380.	306.	145172.	197673.	52427.	2.24	2.24	0.00	7.	7.	52134.
9-15-69	3.83	4.00	5.	666.	661.	215.	224.	298.	39620.	39332.	1.83	1.83	0.00	6.	6.	39038.
10-15-69	5.52	4.00	4259.	5490.	1229.	310.	224.	261876.	337541.	75580.	1.63	1.63	0.00	7.	7.	75287.
11-15-69	1.05	2.89	5394.	6133.	741.	59.	162.	320965.	364953.	44091.	1.22	.67	.56	6.	3390.	47181.
12-15-69	3.12	2.60	3878.	4322.	444.	175.	146.	238449.	265758.	27280.	1.02	1.02	0.00	7.	7.	26987.
TOTAL	47.64	51.44	24986.	32446.	7464.	2673.	2887.	1517776.	1970577.	453014.	20.59	18.44	2.15	78.	13161.	462575.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 70 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-70	4.37	2.26	5801.	6648.	845.	245.	127.	356690.	408773.	51964.	1.02	1.02	0.00	7.	7.	51671.
2-15-70	2.02	2.99	4331.	4783.	453.	113.	168.	240532.	265611.	25134.	1.22	1.22	0.00	6.	6.	24840.
3-15-70	14.06	4.22	3685.	6191.	2497.	789.	237.	226582.	380690.	153556.	1.63	1.63	0.00	7.	7.	153263.
4-15-70	.05	6.05	7425.	7737.	318.	3.	339.	441818.	460408.	18926.	2.04	-.06	2.10	7.	12785.	31411.
5-15-70	6.68	6.54	1314.	1407.	93.	375.	367.	80795.	86499.	5696.	2.45	2.45	0.00	7.	7.	5403.
6-15-70	7.34	6.22	3908.	4622.	713.	412.	349.	232542.	275016.	42411.	2.04	2.04	0.00	7.	7.	42117.
7-15-70	7.81	5.54	3478.	4239.	759.	438.	311.	213854.	260663.	46682.	2.24	2.24	0.00	7.	7.	46388.
8-15-70	4.75	5.87	1209.	1490.	282.	267.	330.	74339.	91594.	17319.	2.24	2.24	0.00	7.	7.	17026.
9-15-70	6.11	5.51	29.	268.	239.	343.	309.	1708.	15951.	14210.	1.83	1.83	0.00	7.	7.	13916.
10-15-70	4.71	5.06	36.	191.	156.	264.	284.	2207.	11767.	9579.	1.63	1.63	0.00	7.	7.	9286.
11-15-70	.10	3.29	125.	62.	-60.	6.	185.	7438.	3707.	-3553.	1.22	-.01	1.23	7.	7507.	3654.
12-15-70	.25	2.85	191.	54.	-135.	14.	160.	11744.	3311.	-8287.	1.02	.12	.90	7.	5494.	-3093.
TOTAL	58.25	56.39	31532.	37692.	6159.	3269.	3165.	1890248.	2263989.	373637.	20.59	16.35	4.24	80.	25846.	395883.

YEAR OF 71 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-71	.41	2.86	134.	31.	-100.	23.	161.	8239.	1926.	-6176.	1.02	.24	.78	7.	4761.	-1715.
2-15-71	1.01	3.34	123.	43.	-78.	57.	187.	6831.	2377.	-4324.	1.22	.64	.58	6.	3542.	-1082.
3-15-71	.35	5.33	329.	149.	-176.	20.	299.	20229.	9152.	-10798.	1.63	.20	1.43	7.	8706.	-2391.
4-15-71	.30	6.06	519.	226.	-287.	17.	340.	30883.	13459.	-17100.	2.04	.17	1.87	7.	11402.	-5998.
5-15-71	3.04	7.10	194.	106.	-85.	171.	399.	11929.	6497.	-5203.	2.45	1.90	.55	7.	3328.	-2175.
6-15-71	11.93	5.74	-58.	52.	104.	669.	322.	-3427.	3094.	6175.	2.04	2.04	0.00	7.	7.	5881.
7-15-71	7.14	5.38	-126.	353.	477.	401.	302.	-7747.	21705.	29354.	2.24	2.24	0.00	7.	7.	29061.
8-15-71	7.45	5.16	-180.	233.	411.	418.	290.	-11068.	14327.	25266.	2.24	2.24	0.00	7.	7.	24973.
9-15-71	6.69	4.51	5.	812.	805.	375.	253.	298.	48317.	47898.	1.83	1.83	0.00	7.	7.	47604.
10-15-71	5.31	3.86	5.	316.	310.	298.	217.	307.	19430.	19041.	1.63	1.63	0.00	7.	7.	18748.
11-15-71	1.26	3.48	42.	112.	72.	71.	195.	2493.	6664.	4296.	1.22	.79	.43	7.	2611.	6607.
12-15-71	1.14	2.96	106.	8.	-96.	64.	166.	6518.	491.	-5924.	1.02	.71	.31	7.	1863.	-4361.
TOTAL	46.03	55.79	1093.	2441.	1357.	2583.	3131.	65484.	147440.	82504.	20.59	14.64	5.95	81.	36249.	115153.

----- EXPLANATION -----
RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 72 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-72	.97	2.74	141.	8.	-131.	54.	154.	8670.	504.	-8066.	1.02	.61	.41	7.	2498.	-5869.
2-15-72	1.83	3.30	89.	10.	-78.	103.	185.	4926.	530.	-4314.	1.22	1.13	.10	6.	598.	-4015.
3-15-72	3.20	5.13	202.	21.	-179.	180.	288.	12420.	1316.	-10996.	1.63	1.63	0.00	7.	7.	-11289.
4-15-72	.58	5.72	220.	49.	-166.	33.	321.	13091.	2916.	-9887.	2.04	.38	1.66	7.	10109.	-78.
5-15-72	4.76	6.40	192.	57.	-134.	267.	359.	11806.	3486.	-8227.	2.45	2.45	0.00	7.	7.	-8520.
6-15-72	10.79	5.93	271.	759.	483.	606.	333.	16126.	45164.	28765.	2.04	2.04	0.00	7.	7.	28472.
7-15-72	4.07	5.98	269.	301.	34.	228.	336.	16540.	18508.	2075.	2.24	2.24	0.00	7.	7.	1782.
8-15-72	6.59	5.46	58.	35.	-24.	370.	306.	3554.	2140.	-1478.	2.24	2.24	0.00	7.	7.	-1771.
9-15-72	1.55	5.46	33.	58.	29.	87.	306.	1934.	3445.	1731.	1.83	1.00	.84	7.	5087.	6517.
10-15-72	1.25	4.94	160.	40.	-116.	70.	277.	9838.	2484.	-7147.	1.63	.81	.82	7.	5017.	-2429.
11-15-72	3.65	2.79	141.	66.	-76.	205.	157.	8390.	3915.	-4523.	1.22	1.22	0.00	7.	7.	-4816.
12-15-72	1.24	2.90	30.	13.	-15.	70.	163.	1826.	818.	-915.	1.02	.77	.25	7.	1499.	283.
TOTAL	40.48	56.75	1805.	1417.	-373.	2272.	3185.	109121.	85226.	-22982.	20.59	16.52	4.07	83.	24849.	-1733.

YEAR OF 73 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-73	3.20	2.36	47.	14.	-33.	180.	132.	2859.	873.	-2033.	1.02	1.02	0.00	7.	7.	-2326.
2-15-73	2.91	2.68	5.	173.	168.	163.	150.	278.	9608.	9317.	1.22	1.22	0.00	6.	6.	9024.
3-15-73	3.38	4.65	49.	15.	-33.	190.	261.	3019.	916.	-2032.	1.63	1.63	0.00	7.	7.	-2325.
4-15-73	1.04	5.90	154.	38.	-112.	58.	331.	9164.	2249.	-6641.	2.04	.69	1.35	7.	8201.	1260.
5-15-73	5.16	6.35	197.	53.	-143.	290.	356.	12113.	3259.	-8787.	2.45	2.45	0.00	7.	7.	-9080.
6-15-73	8.16	5.66	82.	317.	233.	458.	318.	4856.	18863.	13867.	2.04	2.04	0.00	7.	7.	13574.
7-15-73	8.88	5.07	5.	673.	665.	498.	285.	307.	41381.	40860.	2.24	2.24	0.00	7.	7.	40567.
8-15-73	9.13	4.89	5.	1970.	1961.	512.	274.	307.	121131.	120585.	2.24	2.24	0.00	7.	7.	120292.
9-15-73	7.79	4.60	5.	1426.	1418.	437.	258.	298.	84853.	84376.	1.83	1.83	0.00	7.	7.	84083.
10-15-73	1.81	5.46	29.	298.	272.	102.	307.	1777.	18323.	16751.	1.63	1.14	.49	7.	2991.	19443.
11-15-73	.06	3.65	111.	10.	-98.	3.	205.	6605.	601.	-5803.	1.22	-.05	1.27	7.	7745.	1642.
12-15-73	1.59	2.61	81.	7.	-73.	89.	146.	4987.	431.	-4498.	1.02	.98	.04	7.	259.	-4540.
TOTAL	53.11	53.89	769.	4994.	4226.	2980.	3024.	46569.	302488.	255963.	20.59	17.44	3.15	85.	19253.	271616.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 74 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-74	.11	3.00	67.	18.	-47.	6.	168.	4132.	1082.	-2888.	1.02	-.00	1.02	7.	6211.	3023.
2-15-74	.94	3.82	187.	56.	-128.	53.	214.	10385.	3099.	-7125.	1.22	.60	.63	7.	3810.	-3615.
3-15-74	.93	5.80	324.	88.	-231.	52.	325.	19922.	5423.	-14225.	1.63	.61	1.03	7.	6246.	-8279.
4-15-74	1.15	6.54	443.	121.	-317.	65.	367.	26360.	7200.	-18858.	2.04	.76	1.28	7.	7770.	-11388.
5-15-74	5.32	6.73	337.	96.	-240.	299.	378.	20721.	5903.	-14739.	2.45	2.45	0.00	7.	7.	-15032.
6-15-74	18.01	5.34	-352.	643.	983.	1011.	299.	-20945.	38261.	58495.	2.04	2.04	0.00	7.	7.	58202.
7-15-74	13.79	5.34	1085.	3883.	2790.	774.	300.	66714.	238756.	171568.	2.24	2.24	0.00	7.	7.	171276.
8-15-74	7.09	5.04	7058.	8725.	1665.	398.	283.	433980.	536479.	102385.	2.24	2.24	0.00	7.	7.	102092.
9-15-74	7.04	5.21	2659.	3641.	980.	395.	292.	158221.	216655.	58330.	1.83	1.83	0.00	7.	7.	58037.
10-15-74	.95	5.23	11.	71.	64.	53.	294.	646.	4353.	3948.	1.63	.62	1.01	7.	6167.	9815.
11-15-74	2.17	3.49	172.	65.	-106.	122.	196.	10235.	3850.	-6311.	1.22	1.22	0.00	7.	7.	-6604.
12-15-74	1.25	2.24	33.	77.	45.	70.	126.	2023.	4704.	2736.	1.02	.78	.24	7.	1463.	3899.
TOTAL	58.75	57.77	12024.	17483.	5458.	3297.	3242.	732394.	1065766.	333317.	20.59	15.39	5.20	86.	31710.	361427.

YEAR OF 75 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-75	.24	3.30	129.	32.	-95.	13.	185.	7932.	1937.	-5823.	1.02	.11	.91	7.	5543.	-580.
2-15-75	1.54	3.90	147.	74.	-70.	86.	219.	8164.	4121.	-3911.	1.22	.96	.26	7.	1606.	-2605.
3-15-75	.77	5.84	515.	281.	-229.	43.	328.	31666.	17278.	-14104.	1.63	.50	1.13	7.	6888.	-7516.
4-15-75	1.77	7.16	515.	328.	-182.	99.	402.	30645.	19517.	-10825.	2.04	1.14	.90	7.	5455.	-5669.
5-15-75	5.95	7.22	416.	382.	-33.	334.	405.	25579.	23488.	-2019.	2.45	2.45	0.00	7.	7.	-2312.
6-15-75	6.83	6.34	13.	604.	591.	383.	356.	744.	35940.	35169.	2.04	2.04	0.00	7.	7.	34876.
7-15-75	6.37	6.56	5.	636.	631.	357.	368.	307.	39106.	38809.	2.24	2.24	0.00	7.	7.	38517.
8-15-75	4.56	6.54	5.	114.	111.	256.	367.	307.	7010.	6813.	2.24	2.24	0.00	7.	7.	6521.
9-15-75	10.97	5.50	5.	993.	983.	616.	309.	298.	59088.	58483.	1.83	1.83	0.00	7.	7.	58191.
10-15-75	3.86	5.53	5.	244.	241.	217.	310.	307.	15003.	14789.	1.63	1.63	0.00	7.	7.	14497.
11-15-75	.32	4.14	21.	23.	6.	18.	232.	1220.	1363.	357.	1.22	.17	1.05	7.	6394.	6451.
12-15-75	.75	3.63	189.	44.	-142.	42.	204.	11621.	2718.	-8742.	1.02	.47	.55	7.	3349.	-5693.
TOTAL	43.93	65.66	1964.	3755.	1811.	2465.	3685.	118790.	226569.	108998.	20.59	15.79	4.8C	88.	29279.	134677.

----- EXPLANATION -----
RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 76 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-76	.80	3.23	184.	76.	-106.	45.	181.	11314.	4648.	-6529.	1.02	.50	.52	8.	3152.	-3677.
2-15-76	2.27	3.54	306.	167.	-138.	127.	198.	16994.	9275.	-7649.	1.22	1.22	0.00	7.	7.	-7942.
3-15-76	2.40	5.30	260.	234.	-23.	135.	297.	15987.	14388.	-1436.	1.63	1.47	.16	8.	974.	-762.
4-15-76	1.99	6.74	585.	359.	-222.	112.	378.	34810.	21362.	-13181.	2.04	1.27	.77	7.	4671.	-8810.
5-15-76	5.79	5.60	211.	285.	74.	325.	314.	12974.	17524.	4539.	2.45	2.45	0.00	8.	8.	4247.
6-15-76	4.13	4.58	84.	275.	192.	232.	257.	4992.	16364.	11396.	2.04	2.04	0.00	7.	7.	11104.
7-15-76	8.66	6.10	5.	256.	249.	486.	342.	307.	15741.	15289.	2.24	2.24	0.00	8.	8.	14997.
8-15-76	6.99	6.04	5.	880.	874.	392.	339.	307.	54109.	53748.	2.24	2.24	0.00	8.	8.	53456.
9-15-76	5.83	4.72	5.	456.	450.	327.	265.	298.	27134.	26774.	1.83	1.83	0.00	7.	7.	26481.
10-15-76	1.39	4.94	68.	80.	15.	78.	277.	4187.	4919.	931.	1.63	.89	.74	8.	4499.	5129.
11-15-76	2.53	3.29	56.	10.	-45.	142.	185.	3314.	601.	-2671.	1.22	1.22	0.00	7.	7.	-2964.
12-15-76	1.95	2.00	53.	10.	-42.	109.	112.	3240.	627.	-2610.	1.02	1.02	0.00	8.	8.	-2903.
TOTAL	44.73	56.06	1821.	3088.	1277.	2510.	3146.	108726.	186692.	78602.	20.59	18.41	2.18	89.	13355.	88358.

YEAR OF 77 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-77	4.07	3.27	5.	307.	301.	228.	184.	307.	18877.	18524.	1.02	1.02	0.00	8.	8.	18232.
2-15-77	1.13	3.86	17.	42.	28.	63.	216.	927.	2321.	1547.	1.22	.72	.51	7.	3091.	4338.
3-15-77	.52	6.08	134.	114.	-15.	29.	341.	8239.	7010.	-918.	1.63	.33	1.30	8.	7941.	6723.
4-15-77	.24	7.86	640.	297.	-336.	13.	441.	38083.	17573.	-19983.	2.04	.12	1.92	7.	11704.	-8578.
5-15-77	4.92	7.70	536.	812.	279.	276.	432.	32957.	49928.	17126.	2.45	2.45	0.00	8.	8.	16834.
6-15-77	5.11	6.22	470.	484.	15.	287.	349.	27967.	28800.	896.	2.04	2.04	0.00	7.	7.	603.
7-15-77	8.20	6.83	271.	276.	4.	460.	383.	16663.	16971.	231.	2.24	2.24	0.00	8.	8.	-62.
8-15-77	9.19	6.26	5.	356.	348.	516.	352.	307.	21890.	21418.	2.24	2.24	0.00	8.	8.	21126.
9-15-77	8.37	5.55	5.	633.	625.	470.	312.	298.	37666.	37210.	1.83	1.83	0.00	7.	7.	36918.
10-15-77	1.45	5.42	126.	111.	-11.	81.	304.	7747.	6825.	-700.	1.63	.93	.70	8.	4279.	3279.
11-15-77	4.27	4.06	102.	86.	-16.	240.	228.	6069.	5111.	-970.	1.22	1.22	0.00	7.	7.	-1263.
12-15-77	3.96	3.06	5.	420.	414.	222.	171.	307.	25825.	25467.	1.02	1.02	0.00	8.	8.	25174.
TOTAL	51.43	66.16	2316.	3938.	1636.	2886.	3713.	139874.	238896.	99849.	20.59	16.15	4.44	91.	27076.	123325.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CUMSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CUMSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 78 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-78	1.86	2.78	14.	144.	131.	104.	156.	879.	8854.	8027.	1.02	1.02	0.00	8.	8.	7735.
2-15-78	1.85	2.58	14.	48.	35.	104.	145.	755.	2644.	1929.	1.22	1.14	.09	7.	531.	2160.
3-15-78	3.54	4.77	56.	195.	140.	199.	268.	3443.	11990.	8616.	1.63	1.63	0.00	8.	8.	8324.
4-15-78	2.77	6.76	244.	171.	-69.	155.	379.	14519.	10175.	-4120.	2.04	1.71	.33	8.	2001.	-2419.
5-15-78	5.49	6.65	55.	408.	355.	308.	373.	3351.	25087.	21801.	2.45	2.45	0.00	8.	8.	21509.
6-15-78	7.24	5.01	5.	394.	387.	406.	281.	298.	23445.	23022.	2.04	2.04	0.00	8.	8.	22729.
7-15-78	9.92	5.73	5.	820.	811.	557.	321.	307.	50420.	49877.	2.24	2.24	0.00	8.	8.	49585.
8-15-78	5.42	6.06	2935.	4263.	1329.	304.	340.	180466.	262122.	81691.	2.24	2.24	0.00	8.	8.	81399.
9-15-78	7.12	5.19	422.	1090.	666.	400.	291.	25111.	64860.	39641.	1.83	1.83	0.00	8.	8.	39348.
10-15-78	2.97	4.58	5.	271.	267.	167.	257.	307.	16663.	16446.	1.63	1.63	0.00	8.	8.	16154.
11-15-78	2.83	3.63	27.	115.	88.	159.	204.	1630.	6843.	5258.	1.22	1.22	0.00	8.	8.	4965.
12-15-78	2.63	2.98	9.	291.	282.	148.	167.	544.	17893.	17369.	1.02	1.02	0.00	8.	8.	17077.
TOTAL	53.64	56.71	3791.	8210.	4422.	3010.	3183.	231611.	500995.	269556.	20.59	20.17	.41	93.	2609.	268565.

YEAR OF 79 ECALM BASIN BASIN AREA = 238000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-79	6.99	3.52	2737.	3707.	967.	392.	198.	168292.	227935.	59448.	1.02	1.02	0.00	8.	8.	59156.
2-15-79	.60	3.23	3642.	3914.	275.	34.	181.	202266.	217373.	15254.	1.22	.37	.85	7.	5168.	20122.
3-15-79	1.85	4.97	2897.	2937.	43.	104.	279.	178130.	180589.	2634.	1.63	1.16	.47	8.	2852.	5187.
4-15-79	3.65	6.13	291.	108.	-181.	205.	344.	17316.	6426.	-10750.	2.04	2.04	0.00	8.	8.	-11042.
5-15-79	12.02	6.07	5.	1166.	1156.	675.	341.	307.	71695.	71053.	2.45	2.45	0.00	8.	8.	70761.
6-15-79	1.30	7.28	129.	103.	-20.	73.	409.	7676.	6129.	-1212.	2.04	.86	1.18	8.	7194.	5683.
7-15-79	3.28	6.58	20.	98.	81.	184.	369.	1224.	6038.	4999.	2.24	2.01	.23	8.	1430.	6129.
8-15-79	5.58	5.94	50.	169.	119.	313.	334.	3074.	10391.	7337.	2.24	2.24	0.00	8.	8.	7045.
9-15-79	14.58	4.66	5.	1866.	1852.	818.	262.	298.	111035.	110181.	1.83	1.83	0.00	8.	8.	109888.
10-15-79	1.09	4.58	2873.	3787.	917.	61.	257.	176670.	232852.	56377.	1.63	.71	.92	8.	5625.	61702.
11-15-79	1.40	3.68	462.	884.	424.	79.	207.	27519.	52625.	25235.	1.22	.88	.34	8.	2105.	27040.
12-15-79	2.70	2.55	368.	620.	253.	152.	143.	22603.	38142.	15530.	1.02	1.02	0.00	8.	8.	15238.
TOTAL	55.04	59.19	13479.	19360.	5885.	3089.	3322.	805374.	1161229.	356088.	20.59	16.59	4.00	94.	24421.	376909.

----- EXPLANATION -----
RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORDS FURNISHED BY WATER TREATMENT PLANTS
DEMAND TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-300, WHERE 300 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S-77 TO MEET THE DOWNSTREAM DEMAND.

TABLE 7. Basin Yield Water Budget

YEAR OF 80   ECALM BASIN   BASIN AREA = 236000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S77 (CFS)	S78 (CFS)	INFLOW (CFS)	XRAIN (AF)	XEVAP (AF)	S77 (AF)	S78 (AF)	XINFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-80	2.15	2.80	1581.	1926.	346.	121.	157.	97181.	118431.	21287.	1.02	1.02	0.00	8.	8.	20995.
2-15-80	1.77	3.28	4059.	4597.	540.	99.	184.	225420.	255316.	29980.	1.22	1.09	.13	7.	805.	30486.
3-15-80	2.54	5.20	2896.	3056.	163.	143.	292.	178037.	187925.	10036.	1.63	1.55	.08	8.	510.	10246.
4-15-80	3.47	5.28	2648.	3135.	489.	195.	296.	157585.	186551.	29068.	2.04	2.04	0.00	8.	8.	28776.
5-15-80	3.81	6.72	1469.	1526.	60.	214.	377.	90319.	93818.	3662.	2.45	2.32	.13	8.	800.	4162.
6-15-80	1.41	7.12	1038.	843.	-189.	79.	400.	61741.	50160.	-11261.	2.04	.93	1.11	8.	6779.	-4782.
7-15-80	9.23	6.48	57.	199.	140.	518.	364.	3486.	12248.	8608.	2.24	2.24	0.00	8.	8.	8316.
8-15-80	9.08	6.08	11.	568.	555.	510.	341.	676.	34950.	34105.	2.24	2.24	0.00	8.	8.	33813.
9-15-80	4.50	5.52	0.	481.	482.	253.	310.	0.	28645.	28703.	1.83	1.83	0.00	8.	8.	28410.
10-15-80	1.80	4.96	225.	77.	-146.	101.	278.	13853.	4704.	-8972.	1.63	1.13	.50	8.	3027.	-6245.
11-15-80	3.83	3.12	97.	93.	-5.	215.	175.	5772.	5534.	-278.	1.22	1.22	0.00	8.	8.	-570.
12-15-80	.75	2.64	76.	60.	-14.	42.	148.	4685.	3689.	-890.	1.02	.47	.55	8.	3349.	2159.
TOTAL	44.34	59.20	14156.	16562.	2420.	2488.	3322.	838757.	981971.	144048.	20.59	18.08	2.50	96.	15319.	155767.

TABLE 7. Basin Yield Water Budget

YEAR OF 66 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-66	2.49	2.50	213.	532.	318.	227.	228.	13111.	32694.	19584.	1.19	1.19	0.00	0.	0.	18784.
2-15-66	2.92	3.12	213.	532.	319.	266.	285.	11842.	29530.	17706.	1.43	1.43	0.00	0.	0.	16906.
3-15-66	1.00	5.00	2367.	2952.	591.	91.	456.	145564.	181510.	36311.	1.91	.66	1.25	0.	7711.	43222.
4-15-66	4.51	6.54	4313.	5138.	828.	411.	596.	256666.	305756.	49277.	2.39	2.39	0.00	0.	0.	48477.
5-15-66	6.71	6.71	2002.	2241.	239.	612.	612.	123109.	137794.	14665.	2.86	2.86	0.00	0.	0.	13885.
6-15-66	14.12	6.51	3765.	4853.	1076.	1288.	594.	224026.	288774.	64054.	2.39	2.39	0.00	0.	0.	63254.
7-15-66	7.45	5.10	4212.	5636.	1421.	679.	465.	258983.	346544.	87347.	2.63	2.63	0.00	0.	0.	86547.
8-15-66	6.44	5.87	4702.	6350.	1648.	587.	535.	289088.	390446.	101306.	2.63	2.63	0.00	0.	0.	100506.
9-15-66	15.13	4.86	2384.	4371.	1971.	1380.	443.	141879.	260093.	117276.	2.15	2.15	0.00	0.	0.	116476.
10-15-66	2.97	4.66	2353.	2954.	604.	271.	425.	144655.	181634.	37133.	1.91	1.81	.10	0.	638.	36971.
11-15-66	.14	3.82	783.	742.	-36.	13.	348.	46617.	44152.	-2129.	1.43	.03	1.41	0.	8674.	5745.
12-15-66	.96	2.88	74.	117.	46.	88.	263.	4549.	7194.	2820.	1.19	.61	.58	0.	3605.	5625.
TOTAL	64.84	57.56	27382.	36418.	9024.	5913.	5249.	1660091.	2206124.	545369.	24.11	20.77	3.34	0.	20628.	556397.

YEAR OF 67 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-67	2.98	3.21	26.	121.	93.	272.	293.	1714.	7440.	5747.	1.20	1.20	0.00	0.	0.	4947.
2-15-67	2.93	3.22	56.	198.	143.	267.	294.	3105.	10996.	7918.	1.44	1.44	0.00	0.	0.	7118.
3-15-67	.19	5.37	65.	88.	31.	17.	490.	3973.	5417.	1916.	1.92	.07	1.85	0.	11674.	12790.
4-15-67	.13	6.98	209.	10.	-189.	12.	636.	12459.	595.	-11240.	2.40	.02	2.38	0.	15044.	3004.
5-15-67	2.36	7.82	115.	10.	-97.	215.	713.	7059.	615.	-5946.	2.88	1.55	1.32	0.	8369.	1622.
6-15-67	10.76	5.90	585.	1300.	707.	981.	538.	34831.	77355.	42082.	2.40	2.40	0.00	0.	0.	41282.
7-15-67	8.77	6.49	996.	2145.	1144.	800.	592.	61334.	131891.	70348.	2.64	2.64	0.00	0.	0.	69548.
8-15-67	7.13	5.67	787.	1714.	925.	650.	517.	48408.	105390.	56849.	2.64	2.64	0.00	0.	0.	56049.
9-15-67	5.23	5.34	340.	798.	458.	477.	487.	20261.	47484.	27234.	2.16	2.16	0.00	0.	0.	26434.
10-15-67	5.28	5.16	639.	1410.	771.	481.	471.	39291.	86698.	47396.	1.92	1.92	0.00	0.	0.	46596.
11-15-67	.42	3.66	77.	109.	37.	38.	334.	4577.	6486.	2205.	1.44	.25	1.19	0.	7512.	8917.
12-15-67	2.43	3.05	10.	10.	1.	222.	278.	615.	615.	56.	1.20	1.20	0.00	0.	0.	-744.
TOTAL	46.61	61.67	3909.	7913.	4024.	4433.	5642.	237626.	480982.	244565.	24.22	17.49	6.74	0.	42599.	277564.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 68 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-68	.19	2.66	22.	38.	19.	17.	242.	1379.	2349.	1195.	1.20	.07	1.14	0.	7347.	7742.
2-15-68	1.77	3.22	42.	59.	19.	161.	294.	2355.	3260.	1038.	1.45	1.11	.34	0.	2200.	2438.
3-15-68	1.25	5.00	35.	42.	12.	114.	456.	2180.	2601.	763.	1.93	.82	1.11	0.	7163.	7126.
4-15-68	.93	5.66	152.	10.	-134.	85.	517.	9020.	595.	-7993.	2.41	.63	1.78	0.	11502.	2709.
5-15-68	7.06	5.34	254.	547.	290.	644.	487.	15621.	33634.	17856.	2.89	2.89	0.00	0.	0.	17056.
6-15-68	12.81	5.30	3634.	5622.	1976.	1168.	483.	216238.	334532.	117609.	2.41	2.41	0.00	0.	0.	116809.
7-15-68	9.13	5.79	5309.	7169.	1855.	833.	528.	326445.	440805.	114055.	2.65	2.65	0.00	0.	0.	113255.
8-15-68	7.27	5.66	4236.	4631.	393.	663.	516.	260438.	284749.	24164.	2.65	2.65	0.00	0.	0.	23364.
9-15-68	3.90	5.31	482.	1073.	593.	356.	484.	28702.	63848.	35275.	2.17	2.17	0.00	0.	0.	34475.
10-15-68	4.18	4.63	614.	1346.	733.	381.	422.	37743.	82762.	45061.	1.93	1.93	0.00	0.	0.	44261.
11-15-68	2.60	3.26	391.	901.	511.	237.	297.	23250.	53613.	30423.	1.45	1.45	0.00	0.	0.	29623.
12-15-68	.08	2.62	248.	479.	235.	7.	239.	15245.	29453.	14439.	1.20	-.03	1.23	0.	7984.	21623.
TOTAL	51.17	54.45	15419.	21917.	6503.	4666.	4965.	938614.	1332201.	393885.	24.33	18.74	5.59	0.	36195.	420481.

YEAR OF 69 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-69	.93	2.81	54.	211.	160.	85.	256.	3330.	12974.	9815.	1.21	.59	.62	62.	4159.	13173.
2-15-69	.48	3.40	37.	158.	126.	44.	310.	2065.	8775.	6976.	1.45	.29	1.16	56.	7718.	13893.
3-15-69	3.43	3.91	3560.	4558.	999.	313.	357.	218898.	280260.	61406.	1.94	1.94	0.00	62.	62.	60668.
4-15-69	.39	5.24	2024.	2106.	89.	36.	478.	120441.	125316.	5317.	2.42	.24	2.18	60.	14484.	19001.
5-15-69	2.07	6.20	2187.	2634.	454.	189.	565.	134444.	161958.	27691.	2.90	1.38	1.52	62.	10127.	37219.
6-15-69	4.42	5.50	3385.	5008.	1625.	403.	502.	201419.	297997.	96677.	2.42	2.42	0.00	60.	60.	95937.
7-15-69	2.23	5.43	1373.	2145.	777.	203.	495.	84434.	131891.	47749.	2.66	1.46	1.20	62.	8020.	54969.
8-15-69	3.15	5.46	3215.	4153.	942.	287.	498.	197673.	255358.	57895.	2.66	1.98	.68	62.	4544.	61639.
9-15-69	3.65	4.00	666.	1465.	800.	333.	365.	39620.	87174.	47586.	2.18	2.18	0.00	60.	60.	46846.
10-15-69	3.29	4.00	5490.	6772.	1283.	300.	365.	337541.	416394.	78918.	1.94	1.94	0.00	62.	62.	78180.
11-15-69	.34	2.89	6133.	6869.	740.	31.	263.	364953.	408734.	44013.	1.45	.19	1.26	60.	8410.	51623.
12-15-69	4.09	2.60	4322.	4789.	465.	373.	237.	265758.	294464.	28570.	1.21	1.21	0.00	62.	62.	27832.
TOTAL	26.47	51.44	32446.	40868.	6457.	2596.	4691.	1970577.	2481295.	512812.	24.43	15.82	8.61	732.	57769.	560981.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 70 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-70	5.52	2.26	6648.	7486.	833.	503.	206.	408773.	460296.	51226.	1.21	1.21	0.00	172.	172.	50598.
2-15-70	2.28	2.99	4783.	5245.	464.	208.	273.	265611.	291293.	25746.	1.46	1.39	.07	156.	597.	25543.
3-15-70	16.01	4.22	6191.	8829.	2620.	1460.	384.	380690.	542874.	161108.	1.94	1.94	0.00	172.	172.	160481.
4-15-70	.07	6.05	7737.	7970.	242.	6.	552.	460408.	474248.	14385.	2.43	-.04	2.47	167.	16901.	30486.
5-15-70	7.04	6.54	1407.	1574.	166.	642.	596.	86499.	96781.	10237.	2.91	2.91	0.00	172.	172.	9609.
6-15-70	6.18	6.22	4622.	5371.	749.	564.	568.	275016.	319597.	44585.	2.43	2.43	0.00	167.	167.	43952.
7-15-70	6.59	5.54	4239.	5050.	809.	601.	505.	260663.	310512.	49753.	2.67	2.67	0.00	172.	172.	49126.
8-15-70	5.49	5.87	1490.	1857.	368.	501.	535.	91594.	114182.	22623.	2.67	2.67	0.00	172.	172.	21995.
9-15-70	7.22	5.51	268.	624.	353.	658.	503.	15951.	37131.	21024.	2.19	2.19	0.00	167.	167.	20390.
10-15-70	2.72	5.06	191.	459.	271.	248.	462.	11767.	28223.	16670.	1.94	1.67	.27	172.	1991.	17861.
11-15-70	.60	3.29	62.	98.	40.	55.	300.	3707.	5855.	2394.	1.46	.38	1.08	167.	7467.	9060.
12-15-70	.42	2.85	54.	10.	-40.	38.	260.	3311.	615.	-2475.	1.21	.25	.97	172.	6721.	3446.
TOTAL	60.14	56.39	37692.	44573.	6876.	5484.	5142.	2263989.	2681607.	417276.	24.53	19.68	4.85	2030.	34873.	442549.

YEAR OF 71 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-71	.32	2.86	31.	25.	-2.	29.	261.	1926.	1549.	-144.	1.22	.17	1.05	283.	7525.	6581.
2-15-71	1.66	3.34	43.	61.	21.	151.	304.	2377.	3366.	1141.	1.46	1.04	.42	255.	3161.	3502.
3-15-71	.19	5.33	149.	56.	-85.	17.	486.	9152.	3449.	-5234.	1.95	.07	1.88	283.	13287.	7254.
4-15-71	1.56	6.06	226.	10.	-209.	142.	552.	13459.	595.	-12454.	2.44	1.04	1.40	274.	9954.	-3300.
5-15-71	5.10	7.10	106.	113.	10.	465.	648.	6497.	6948.	633.	2.93	2.93	0.00	283.	283.	116.
6-15-71	9.60	5.74	52.	274.	216.	875.	524.	3094.	16304.	12858.	2.44	2.44	0.00	274.	274.	12332.
7-15-71	8.24	5.38	353.	993.	636.	751.	491.	21705.	61057.	39092.	2.68	2.68	0.00	283.	283.	38574.
8-15-71	9.02	5.16	233.	1084.	845.	823.	471.	14327.	66653.	51974.	2.68	2.68	0.00	283.	283.	51457.
9-15-71	7.17	4.51	812.	2411.	1595.	654.	411.	48317.	143464.	94905.	2.19	2.19	0.00	274.	274.	94378.
10-15-71	6.87	3.86	316.	1234.	914.	626.	352.	19430.	75876.	56171.	1.95	1.95	0.00	283.	283.	55654.
11-15-71	1.30	3.48	112.	357.	248.	119.	317.	6664.	21243.	14777.	1.46	.83	.63	274.	4656.	18633.
12-15-71	.67	2.96	8.	86.	81.	61.	270.	491.	5263.	4981.	1.22	.42	.80	283.	5801.	9982.
TOTAL	51.70	55.79	2441.	6703.	4269.	4715.	5088.	147440.	405768.	258701.	24.62	18.45	6.17	3329.	46062.	295163.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 72 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-72	1.11	2.74	6.	31.	25.	101.	249.	504.	1894.	1538.	1.22	.70	.52	393.	4069.	4807.
2-15-72	1.90	3.30	10.	109.	102.	173.	301.	530.	6054.	5652.	1.47	1.18	.29	355.	2385.	7237.
3-15-72	3.20	5.13	21.	33.	15.	292.	468.	1316.	2054.	914.	1.96	1.93	.02	393.	555.	669.
4-15-72	1.07	5.72	49.	119.	77.	98.	522.	2916.	7081.	4589.	2.45	.73	1.72	380.	12547.	16336.
5-15-72	2.15	6.40	57.	57.	6.	196.	584.	3486.	3474.	375.	2.94	1.43	1.50	393.	11020.	10595.
6-15-72	11.33	5.93	759.	1458.	691.	1033.	541.	45164.	86757.	41101.	2.45	2.45	0.00	380.	380.	40681.
7-15-72	5.57	5.98	301.	546.	246.	508.	546.	18508.	33572.	15102.	2.69	2.69	0.00	393.	393.	14695.
8-15-72	8.08	5.46	35.	228.	189.	737.	498.	2140.	14019.	11640.	2.69	2.69	0.00	393.	393.	11233.
9-15-72	3.90	5.46	58.	370.	314.	356.	498.	3445.	22017.	18713.	2.20	2.20	0.00	380.	380.	18293.
10-15-72	1.01	4.94	40.	85.	50.	92.	451.	2484.	5208.	3083.	1.96	.67	1.29	393.	9511.	11793.
11-15-72	6.67	2.79	66.	369.	297.	608.	255.	3915.	21957.	17688.	1.47	1.47	0.00	380.	380.	17268.
12-15-72	1.32	2.90	13.	195.	184.	120.	265.	818.	11990.	11317.	1.22	.83	.39	393.	3170.	13687.
TOTAL	47.31	56.75	1417.	3599.	2196.	4314.	5175.	85226.	216076.	131712.	24.71	18.98	5.73	4627.	45183.	167295.

YEAR OF 73 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-73	4.04	2.36	14.	223.	206.	368.	215.	873.	13712.	12685.	1.23	1.23	0.00	503.	503.	12389.
2-15-73	2.58	2.68	173.	592.	419.	235.	244.	9608.	32878.	23279.	1.47	1.47	0.00	455.	455.	22934.
3-15-73	5.31	4.65	15.	395.	379.	484.	424.	916.	24288.	23311.	1.96	1.96	0.00	503.	503.	23014.
4-15-73	1.43	5.90	38.	134.	103.	130.	538.	2249.	7974.	6132.	2.45	.96	1.50	487.	11293.	16625.
5-15-73	1.54	6.35	53.	10.	-36.	140.	579.	3259.	615.	-2205.	2.95	1.06	1.89	503.	14154.	11149.
6-15-73	7.21	5.66	317.	548.	229.	657.	517.	18863.	32608.	13604.	2.45	2.45	0.00	487.	487.	13291.
7-15-73	12.65	5.07	673.	1645.	961.	1154.	463.	41381.	101147.	59075.	2.70	2.70	0.00	503.	503.	58778.
8-15-73	8.77	4.89	1970.	2537.	561.	800.	446.	121131.	155994.	34509.	2.70	2.70	0.00	503.	503.	34213.
9-15-73	6.42	4.60	1426.	2603.	1174.	585.	419.	84853.	154889.	69670.	2.21	2.21	0.00	487.	487.	69557.
10-15-73	2.53	5.46	298.	762.	468.	231.	498.	18323.	46854.	28798.	1.96	1.57	.39	503.	3338.	31336.
11-15-73	.51	3.65	10.	29.	24.	47.	333.	601.	1743.	1429.	1.47	.32	1.16	487.	8844.	9473.
12-15-73	1.23	2.61	7.	104.	99.	112.	238.	431.	6395.	6089.	1.23	.78	.45	503.	3759.	9048.
TOTAL	54.22	53.89	4994.	9582.	4588.	4944.	4914.	302488.	579096.	276578.	24.80	19.41	5.38	5925.	44829.	311807.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE, EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 74 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-74	.12	3.00	18.	20.	6.	11.	274.	1082.	1205.	386.	1.23	.01	1.22	613.	9636.	9222.
2-15-74	.96	3.82	56.	21.	-30.	88.	348.	3099.	1177.	-1661.	1.48	.62	.86	554.	6889.	4428.
3-15-74	.13	5.80	88.	10.	-70.	12.	529.	5423.	615.	-4291.	1.97	.02	1.95	613.	15016.	9924.
4-15-74	1.23	6.54	121.	18.	-95.	112.	596.	7200.	1059.	-5657.	2.46	.83	1.63	594.	12623.	6166.
5-15-74	6.21	6.73	96.	154.	59.	566.	614.	5903.	9469.	3614.	2.96	2.96	0.00	613.	613.	3427.
6-15-74	15.91	5.34	643.	1940.	1281.	1451.	487.	38261.	115438.	76213.	2.46	2.46	0.00	594.	594.	76006.
7-15-74	11.42	5.34	3883.	7376.	3484.	1041.	487.	238756.	453533.	214222.	2.71	2.71	0.00	613.	613.	214036.
8-15-74	7.25	5.04	8725.	10750.	2022.	661.	460.	536479.	660992.	124311.	2.71	2.71	0.00	613.	613.	124124.
9-15-74	7.58	5.21	3641.	5248.	1603.	691.	475.	216655.	312278.	95407.	2.22	2.22	0.00	594.	594.	95201.
10-15-74	.45	5.23	71.	311.	247.	41.	477.	4353.	19123.	15205.	1.97	.28	1.69	613.	13078.	27483.
11-15-74	1.73	3.49	65.	64.	2.	158.	318.	3850.	3784.	95.	1.48	1.08	.39	594.	3496.	2790.
12-15-74	1.09	2.24	77.	212.	137.	99.	204.	4704.	13035.	8436.	1.23	.69	.54	613.	4595.	12232.
TOTAL	54.08	57.77	17483.	26123.	8646.	4932.	5268.	1065766.	1591708.	526279.	24.88	16.59	8.29	7223.	68361.	585040.

YEAR OF 75 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-75	.32	3.30	32.	25.	-2.	29.	301.	1937.	1513.	-152.	1.24	.17	1.06	724.	8720.	7768.
2-15-75	1.09	3.90	74.	10.	-60.	99.	355.	4121.	555.	-3310.	1.48	.70	.78	654.	6533.	2423.
3-15-75	.89	5.64	281.	201.	-73.	81.	533.	17278.	12359.	-4468.	1.98	.59	1.39	724.	11160.	5893.
4-15-75	2.85	7.16	328.	174.	-147.	260.	653.	19517.	10354.	-8771.	2.47	1.80	.67	700.	5771.	-3800.
5-15-75	6.85	7.22	382.	318.	-63.	625.	659.	23488.	19553.	-3901.	2.96	2.96	0.00	724.	724.	-3977.
6-15-75	6.63	6.34	604.	855.	251.	605.	578.	35940.	50876.	14909.	2.47	2.47	0.00	700.	700.	14809.
7-15-75	8.15	6.56	636.	1745.	1107.	743.	598.	39106.	107296.	68045.	2.72	2.72	0.00	724.	724.	67969.
8-15-75	6.90	6.54	114.	705.	590.	629.	597.	7010.	43349.	36307.	2.72	2.72	0.00	724.	724.	36230.
9-15-75	7.26	5.50	993.	1917.	921.	662.	502.	59088.	114069.	54822.	2.22	2.22	0.00	700.	700.	54722.
10-15-75	5.09	5.53	244.	942.	699.	464.	504.	15003.	57921.	42958.	1.98	1.98	0.00	724.	724.	42882.
11-15-75	.48	4.14	23.	62.	44.	44.	377.	1363.	3665.	2636.	1.48	.30	1.19	700.	9635.	11475.
12-15-75	.68	3.63	44.	21.	-19.	62.	331.	2718.	1267.	-1182.	1.24	.43	.81	724.	6794.	4812.
TOTAL	47.19	65.66	3755.	6974.	3247.	4303.	5988.	226569.	422777.	197893.	24.96	19.06	5.90	8522.	52913.	241206.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATM [illegible]TS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 76 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-76	.83	3.23	76.	56.	-16.	76.	295.	4648.	3462.	-968.	1.24	.53	.71	834.	6295.	4528.
2-15-76	1.99	3.54	167.	460.	296.	181.	322.	9275.	25547.	16413.	1.49	1.23	.25	753.	2703.	18316.
3-15-76	1.56	5.30	234.	236.	8.	142.	483.	14388.	14511.	464.	1.98	1.01	.97	834.	8274.	7937.
4-15-76	1.22	6.74	359.	192.	-159.	111.	615.	21362.	11425.	-9433.	2.48	.83	1.65	807.	13489.	3256.
5-15-76	6.97	5.60	285.	342.	55.	636.	511.	17524.	21029.	3380.	2.97	2.97	0.00	834.	834.	3414.
6-15-76	8.79	4.58	275.	627.	346.	802.	417.	16364.	37309.	20561.	2.48	2.48	0.00	807.	807.	20568.
7-15-76	9.69	6.10	256.	688.	427.	884.	556.	15741.	42303.	26235.	2.73	2.73	0.00	834.	834.	26269.
8-15-76	5.54	6.04	880.	1637.	758.	505.	551.	54109.	100655.	46592.	2.73	2.73	0.00	834.	834.	46626.
9-15-76	7.08	4.72	456.	1035.	575.	646.	430.	27134.	61587.	34238.	2.23	2.23	0.00	807.	807.	34245.
10-15-76	2.08	4.94	80.	188.	112.	190.	450.	4919.	11560.	6901.	1.98	1.32	.66	834.	5925.	12026.
11-15-76	2.86	3.29	10.	135.	126.	261.	300.	601.	8033.	7471.	1.49	1.49	0.00	807.	807.	7478.
12-15-76	2.21	2.00	10.	39.	28.	202.	182.	627.	2392.	1746.	1.24	1.24	0.00	834.	834.	1780.
TOTAL	50.82	56.06	3088.	5635.	2555.	4634.	5113.	186692.	339813.	153599.	25.03	20.78	4.25	9820.	42444.	186443.

YEAR OF 77 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-77	4.28	3.27	307.	527.	219.	390.	298.	18877.	32404.	13435.	1.24	1.24	0.00	944.	944.	13580.
2-15-77	.50	3.86	42.	133.	97.	46.	352.	2321.	7386.	5371.	1.49	.31	1.18	853.	10104.	14675.
3-15-77	.18	6.08	114.	92.	-14.	16.	554.	7010.	5632.	-839.	1.99	.06	1.92	944.	16014.	14375.
4-15-77	.51	7.86	297.	135.	-151.	47.	716.	17673.	8033.	-8970.	2.49	.34	2.15	914.	17752.	7982.
5-15-77	5.06	7.70	812.	782.	-26.	463.	702.	49928.	48083.	-1606.	2.98	2.98	0.00	944.	944.	-1462.
6-15-77	4.31	6.22	484.	773.	292.	393.	568.	28800.	45997.	17371.	2.49	2.49	0.00	914.	914.	17485.
7-15-77	8.57	6.83	276.	767.	488.	782.	623.	16971.	47161.	30032.	2.73	2.73	0.00	944.	944.	30176.
8-15-77	7.53	6.26	356.	1173.	815.	687.	571.	21890.	72125.	50120.	2.73	2.73	0.00	944.	944.	50264.
9-15-77	6.65	5.55	633.	1550.	915.	606.	506.	37666.	92231.	54465.	2.24	2.24	0.00	914.	914.	54579.
10-15-77	1.12	5.42	111.	105.	.	102.	494.	6825.	6456.	23.	1.99	.74	1.25	944.	10712.	9935.
11-15-77	1.75	4.06	86.	90.	7.	160.	370.	5111.	5343.	442.	1.49	1.10	.39	914.	4002.	3645.
12-15-77	3.11	3.06	420.	747.	327.	284.	279.	25825.	45931.	20102.	1.24	1.24	0.00	944.	944.	20246.
TOTAL	43.59	66.16	3938.	6873.	2970.	3975.	6033.	238896.	416784.	179946.	25.10	18.20	6.90	11118.	65134.	235480.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION

EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED

INFLOW: COMPUTED AS S79-S78+EVAP-RAIN

ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS

RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD

IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA

PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS

DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR

YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 78 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-78	2.67	2.76	144.	308.	164.	243.	254.	8854.	18938.	10094.	1.25	1.25	0.00	1055.	1055.	10349.
2-15-78	2.76	2.56	48.	204.	156.	254.	235.	2644.	11330.	8667.	1.50	1.50	0.00	952.	952.	8820.
3-15-78	3.70	4.77	195.	715.	522.	337.	435.	11990.	43964.	32071.	1.99	1.99	0.00	1055.	1055.	32325.
4-15-78	1.06	6.76	171.	62.	-101.	97.	616.	10175.	3660.	-5996.	2.49	.72	1.77	1021.	15146.	8350.
5-15-78	4.41	6.65	408.	485.	80.	402.	606.	25087.	29821.	4939.	2.99	2.71	.28	1055.	3290.	7429.
6-15-78	11.46	5.01	394.	817.	413.	1045.	457.	23445.	48615.	24582.	2.49	2.49	0.00	1021.	1021.	24802.
7-15-78	10.00	5.73	820.	1855.	1029.	912.	522.	50420.	114060.	63250.	2.74	2.74	0.00	1055.	1055.	63505.
8-15-78	6.69	6.06	4263.	4063.	-201.	610.	552.	262122.	249824.	-12355.	2.74	2.74	0.00	1055.	1055.	-12101.
9-15-78	5.95	5.19	1090.	1758.	667.	543.	473.	64860.	104608.	39680.	2.24	2.24	0.00	1021.	1021.	39900.
10-15-78	2.42	4.58	271.	643.	375.	221.	418.	16663.	39537.	23071.	1.99	1.51	.48	1055.	4892.	27162.
11-15-78	2.37	3.63	115.	235.	122.	216.	331.	6843.	13983.	7256.	1.50	1.44	.05	1021.	1428.	7884.
12-15-78	3.34	2.98	291.	455.	163.	305.	271.	17893.	27977.	10051.	1.25	1.25	0.00	1055.	1055.	10305.
TOTAL	56.85	56.71	8210.	11600.	3390.	5184.	5172.	500995.	706316.	205309.	25.17	22.59	2.58	12416.	33023.	228731.

YEAR OF 79 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-79	7.16	3.52	3707.	4088.	376.	653.	321.	227935.	251361.	23095.	1.25	1.25	0.00	1165.	1165.	23460.
2-15-79	1.06	3.23	3914.	4172.	262.	97.	295.	217373.	231701.	14527.	1.50	.68	.82	1052.	7687.	21414.
3-15-79	1.65	4.97	2937.	3033.	101.	150.	453.	180589.	186492.	6205.	2.00	1.07	.93	1165.	8730.	14135.
4-15-79	3.71	6.13	108.	84.	-20.	338.	559.	6426.	5016.	-1190.	2.50	2.27	.23	1127.	2994.	1004.
5-15-79	7.30	6.07	1166.	915.	-253.	666.	554.	71695.	56261.	-15545.	3.00	3.00	0.00	1165.	1165.	-15181.
6-15-79	1.71	7.28	103.	192.	98.	156.	664.	6129.	11425.	5804.	2.50	1.14	1.36	1127.	12211.	17215.
7-15-79	5.35	6.58	98.	363.	267.	488.	600.	6038.	22320.	16394.	2.75	2.75	0.00	1165.	1165.	16759.
8-15-79	5.74	5.94	169.	340.	171.	523.	542.	10391.	20906.	10533.	2.75	2.75	0.00	1165.	1165.	10898.
9-15-79	10.81	4.66	1866.	4408.	2533.	986.	425.	111035.	262294.	150699.	2.25	2.25	0.00	1127.	1127.	151026.
10-15-79	1.57	4.58	3787.	5868.	2085.	143.	417.	232852.	360806.	128228.	2.00	1.02	.98	1165.	9121.	136549.
11-15-79	1.26	3.68	884.	1349.	468.	115.	336.	52625.	80247.	27843.	1.50	.81	.69	1127.	6755.	33798.
12-15-79	3.77	2.55	620.	1454.	832.	344.	233.	38142.	89385.	51132.	1.25	1.25	0.00	1165.	1165.	51497.
TOTAL	51.09	59.19	19360.	26266.	6918.	4659.	5398.	1161229.	1578215.	417724.	25.24	20.23	5.01	13715.	54449.	462573.

----- EXPLANATION -----

RAIN: CHANNEL PRECIPITATION
EVAP: CHANNEL EVAPORATION, 0.8 PAN EVAPORATION COEFFICIENT ASSUMMED
INFLOW: COMPUTED AS S79-S78+EVAP-RAIN
ET: CONSUMPTIVE OR EVAPOTRANSPIRATION DEMAND OF CROPS
RE: RAINFALL EFFECTIVE IN SATISFYING THE ET, ESTIMATED BY SCS TR-20 METHOD
IRR: IRRIGATION DEMAND=ET-RE,EXPRESSED IN INCHES OVER IRRIGATED AREA
PUB: PUBLIC WATER DEMAND COMPILED FROM PUMPAGE RECORD FURNISHED BY WATER TREATMENT PLANTS
DEMAND: TOTAL CONSUMPTIVE DEMAND=PUB+IRR
YIELD: SAFE YIELD=INFLOW+ DEMAND-800, WHERE 800 IS THE MINIMUM FLOW REQUIREMENT.
NEGATIVE YIELD INDICATES THE NET AMOUNT RELEASED FROM S78 TO MEET THE DOWNSTREAM DEMAND

TABLE 7. Basin Yield Water Budget

YEAR OF 80 WCALM BASIN BASIN AREA = 380000 ACRES

DATE	RAIN (IN)	EVAP (IN)	S78 (CFS)	S79 (CFS)	INFLOW (CFS)	RAIN (AF)	EVAP (AF)	S78 (AF)	S79 (AF)	INFLOW (AF)	ET (IN)	RE (IN)	IRR (IN)	PUB (AF)	DEMAND (AF)	YIELD (AF)
1-15-80	2.15	2.80	1926.	2627.	702.	196.	255.	118431.	161553.	43181.	1.25	1.25	0.00	1275.	1275.	43656.
2-15-80	1.77	3.26	4597.	5667.	1072.	161.	299.	255316.	314735.	59557.	1.50	1.11	.39	1152.	4416.	63173.
3-15-80	2.54	5.20	3056.	3807.	755.	232.	474.	187925.	234102.	46420.	2.00	1.58	.42	1275.	4782.	50402.
4-15-80	3.47	5.28	3135.	3909.	777.	316.	481.	186551.	232620.	46233.	2.51	2.14	.36	1234.	4249.	49682.
5-15-80	3.81	6.72	1526.	2023.	501.	347.	613.	93818.	124371.	30819.	3.01	2.39	.62	1275.	6385.	36404.
6-15-80	1.41	7.12	843.	926.	92.	129.	649.	50160.	55119.	5479.	2.51	.95	1.56	1234.	14118.	18797.
7-15-80	9.23	6.48	199.	587.	384.	842.	591.	12248.	36106.	23606.	2.76	2.76	0.00	1275.	1275.	24081.
8-15-80	9.08	6.08	566.	1360.	807.	828.	554.	34950.	84822.	49599.	2.76	2.76	0.00	1275.	1275.	50074.
9-15-80	4.50	5.52	481.	2134.	1655.	410.	503.	28645.	127006.	98453.	2.25	2.25	0.00	1234.	1234.	98887.
10-15-80	1.80	4.96	77.	203.	131.	164.	452.	4704.	12464.	8048.	2.00	1.16	.85	1275.	8282.	15530.
11-15-80	3.83	3.12	93.	251.	157.	349.	285.	5534.	14924.	9325.	1.50	1.50	0.00	1234.	1234.	9759.
12-15-80	.75	2.64	60.	51.	-7.	68.	241.	3689.	3105.	-412.	1.25	.48	.78	1275.	7707.	6495.
TOTAL	44.34	59.20	16562.	23565.	7026.	4043.	5399.	981971.	1400924.	420308.	25.30	20.33	4.98	15013.	56233.	466941.

TABLE 7. Basin Yield Water Budget

REFERENCES

Bogess, D. H. and Missimer, T. H. 1975. A Reconnaissance of the Hydrogeologic Conditions in Lehigh Acres and Adjacent Areas of Lee County, Florida. U.S.G.S. Open File Report No. 75-55.

Healy, H. May 1974. Potentiometric Surface and Areas of Artesian Flow of Floridan Aquifer in Florida. Bureau of Geology, Florida Dept. of Natural Resources, Map Series No. 73, (1975).

LaRose, Henry R. and McPherson, Benjamin F. 1980. Hydrologic and Land-Cover Feature of the Caloosahatchee River Basin, Lake Okeechobee to Franklin Lock, Florida. U.S.G.S. Water Resource Investigation Open File Report No. 80-732.

Mierau, Ronald. 1974. Supplemental Water Use in the Everglades Agricultural Area. Central and Southern Florida Flood Control District.

Mierau, Taylor, Irons and Storch. 1974. Surface Water Availability in the Caloosahatchee River Basin. South Florida Water Management District Memorandum Report.

Miller, Thomas H. 1980. Water Quality Aspects of the Caloosahatchee River System, Phase II, 1978 to 1979. South Florida Water Management District Technical Memorandum.

Smith, David B. 1955. A Study of the Hydrologic Characteristics of the Caloosahatchee River Basin. Central and Southern Florida Flood Control District.

U. S. Army Corps of Engineers. Caloosahatchee River and Control Structures, 1957 to 1964, Central and South Florida Project, Part IV, Supplement 6 and 23, Detail Design Memorandum.

U.S.G.S. Water Resources. 1977. Estimated Water Use in Florida. Investigations No. 79-112.

______________________. 1975. Sources, Use, and Disposition of Water in Florida.

U. S. Soil Conservation Service. 1967. Irrigation Requirements. Technical Release No. 21.

Wedderburn, Leslie, et al. Hydrogeologic Reconnaissance of Lee County, Florida. South Florida Water Management District Technical Publication No. 82-1.